THURSDAY, NOVEMBER 24, 1892.

ANIMALS' RIGHTS.

Animals' Rights. By H. S. Salt. (London: Bell, 1892.)

THIS little volume is divided into three main parts, the principle upon which the rights of animals are founded, the various ways in which they have been infringed, and the reforms necessary to secure their full recognition. Notwithstanding, however, the logical form in which the subject is thus set forth, the book is absolutely useless both from the ethical and the practical points of view. In the first place the author nowhere attempts to define the relative value of the lower animals as compared with the human race, and although he certainly allows that they possess less "distinctive individuality," he condemns the use of the terms by which they are commonly designated (such as dumb beast, live stock, or even animal), on account of the imputation of inferiority which is involved in them.

He seems to be totally unaware that not only is the natural affection of animals far less enduring, and their intellect immeasurably weaker, but that of morality, *i.e.* the doing of right for right's sake alone, unswayed by personal feeling or the influence of others, they have absolutely no conception whatever.

Ignoring, however, these fundamental distinctions from which the subjection of animals inevitably follows, Mr. Salt at once proceeds to enunciate his theory of their rights.

This whole question, however, is thrown into absolute chaos by the fact that, for subsequent dealing with the practical aspects of his subject, the author has equipped himself with not merely one but two definitions of animals' rights, differing from each other so widely that while the one involves the unconditional prohibition to kill, eat, or use any harmless animal, the other would admit of all these things being done for good cause shown. Thus on page 9 we find that they have the right to live their own lives with a due measure of that restricted freedom of which Herbert Spencer speaks, *i.e.* the freedom to do that which they will, provided they infringe not the equal liberty of any other. Except, therefore, in the case of the beasts of prey, who no doubt would "will" to eat man if a convenient opportunity offered, the liberty to sacrifice the lives of animals for human food or indeed to employ them in any way is cut off without reserve. Turn, however, to page 28 and we find that this freedom of animals is no longer restricted merely by the equal freedom of others, but is also "subject to the limitations imposed by the permanent needs and interests of the whole community." A life of idleness and a death from disease or old age and starvation are no longer secured to them, and the whole principle of the subordination of the interests of the lower race to those of the higher is conceded.

From the confusion of mind thus exhibited suggestions of practical value can scarcely be expected, nor indeed do we find them in the succeeding parts of the work. Thus we are told that "the contention that man is not morally justified in imposing any sort of subjection on the lower animals" is one which the author "desires to keep clear of," and pronounces to be "an abstract question beyond the scope of the present enquiry," yet, as he also states "that no human being is justified in considering any animal as a meaningless automaton to be worked, tortured, or eaten for the mere object of satisfying the wants or whims of mankind," we would submit that he has not kept clear of the matter at all, as we cannot call to mind any forms of subjection which are not included in these three.

In his discussion of the treatment of domestic animals we would only draw attention to that passage wherein the degrading practice of pampering lap-dogs is rebuked as unworthy of their moral dignity! In the succeeding chapters the employment of animals in personal decoration, sport, and scientific experiment is dilated upon and condemned, and it then only remains to consider the question of the reforms which ought to be instituted.

The first remedy proposed is that of education. We are all to be taught to be humane, but seeing that this has been, for countless generations, carried into effect by almost every mother with almost every child, the suggestion can hardly be accounted novel nor need any great changes in the present condition of affairs be expected from it. Further, there must be a crusade preached against the disregard of the kinship of animals to ourselves, and the laugh must be turned from the so-called sentimentalists (*i.e.* those agreeing with the author's views) against certain flesh eaters, sportsmen, and scientific experimentalists whom he seems to have in his mind's eye, and who, seeing that he represents them as advancing absolutely foolish reasons for practices which they could easily defend on common-sense grounds, are very properly described by him as "cranks."

The second reform is to be found in legislation, and it might naturally be supposed that this should first be applied in that case which Mr. Salt considers to be productive of the greatest bulk of suffering, namely in that of flesh eating. But this is not so; he has already said that it is no part of his present purpose to advocate vegetarianism, and he discreetly leaves it to look after itself. Then after suggesting that the worrying of tame animals might be classed as baiting, and that improvements (though what and how he does not say) might be made in the transport of animals, and by substituting public for private slaughter-houses, he demands that the full fury of the law should be turned on to scientific experiment, which must be totally abolished.

The demand thus made he bases on two grounds:—(1) That nothing is necessary which is abhorrent to the general conscience of humanity, and (2) That it involves hideous injustice to innocent animals, quoting with approval Miss Cobbe's, in this case, specious axiom, that the minimum of all possible rights is to be spared the worst of all possible wrongs.

How far either of these arguments is applicable here we propose to briefly touch upon.

In the first place no proof whatever exists that scientific experiment *is* abhorrent to the general conscience, seeing that England is the only country where it is even under legislative supervision, that there, after the most careful deliberation, it is freely allowed on good cause shown, and that the whole body of those qualified to

judge strongly advocate it. Supported, therefore, as we have shown it to be, by the legal and moral sanction of the civilized and scientific world, it follows that the "general conscience" of which Mr. Salt speaks must find its local habitation in the minds of a class of persons about as enlightened as those who fomented the riots against the study of anatomy, a noisy and violent agitation, which has died the natural death of ignorant prejudice.

For the refutation of the second proposition, viz. that of the cruel *wrong* done to an innocent animal by sacrificing it for the good of others, we must refer Mr. Salt to his own principle of animals' rights, in which the freedom conceded to them to live their own lives is very properly made "subject to the limitations imposed by the permanent needs and interests of the community," and we fail to see how the logical application of an acknowledged right can be supposed to involve the infliction of a "cruel wrong."

The contention of the scientific experimentalist is exactly that which is here conceded by Mr. Salt, viz. that the interests of individuals of the lower race must morally be treated as subordinate to those of the higher, and that while men are bound to benevolently regard all harmless animals, and never to inflict pain upon them wantonly, they not only may but ought to do so when the suffering thus caused is but one-tenth in intensity and one-millionth in quantity of that which it is designed to avert from both mankind and the lower animals. The whole matter is in truth a rule of three sum, and unless the anti-vivisectionist can successfully demonstrate that the scientific statement of accounts is false, his outcry is but the confession of the immoral fact that, rather than inflict an infinitely less amount of physical suffering upon some individuals of a lower race, he wilfully prefers to perpetuate a far greater amount of both physical and psychical agony among the whole community of animals and men. When such an avowal of callousness can be seriously advanced in the name of humanity we are tempted to believe that chaos is come again.

We should not omit to mention that Mr. Salt appears to be an ardent republican, and that he looks for the advent of his animal millenniun upon the establishment of an "enlightened sense of equality," but whether of men with animals, of both with insects, or all three with bacteria, he does not say, nor are we concerned to enquire.

ELEMENTARY PHYSIOGRAPHY.

A Description of the Laws and Wonders of Nature. By Richard A. Gregory, F.R.A.S. (London: Jos. Hughes and Co.)

NOTWITHSTANDING the numerous text-books that have been issued from time to time on this subject, it seems to Mr. Gregory that there is still room for another, for whose appearance, however, he apologizes and offers an explanation.

A work on physiography is not, as some people, who ought to know better, seem to think, limited to the study of physical geography. At least that is not the view, the author emphatically asserts, of Profs. Judd and Lockyer, whose opinion in this matter is final for the students interested. Neither is it a work on astronomy, nor chemistry, nor geology, nor any specialized science, whose aim and scope are recognized and defined, though doubtless it is allied to all. As soon as an author treats of any of these subjects in detail, he is travelling beyond the record. To this fact Mr. Gregory is fully alive. His object, if we have understood him correctly, consists rather in showing that some knowledge of all branches of physical science is necessary for the pursuit of one, and this kind of general knowledge he considers comprised under the generic term, physiography. It is the kind of information which every so-called educated person ought to possess, and without which he is not educated.

It may not seem a very ambitious task to write a book to meet the requirements of a syllabus, and our author thinks it necessary to defend himself against the charge of producing a cram book, addressed to the few ambitious of possessing a South Kensington certificate. But the task need not be the less useful or the less necessary on that account. Indeed, there is one circumstance connected with the appearance of this book which is very satisfactory, and should be a subject for congratulation. The author asserts that the book is rendered essential from the fact that the examiners have found it necessary or desirable to raise their standard for examination. This means that the Department has proved, that the general character of the education given to tnose classes from which the candidates for examination are drawn has so improved that a greater amount of information can be demanded than was formerly the case.

But independently of the fact that the author addresses himself principally to those preparing for the ordeal of examination, he has produced a very readable book, a little too much like an encyclopædia perhaps for ordinary tastes, but replete with a vast deal of information, by no means ill-arranged and generally expressed with exactness; but the effort to impart and to treat lightly and discursively of many branches of information is apt to give to the book a disconnected and incoherent aspect, and this is the principal defect that can be urged against the work. As soon as a subject is introduced it is necessary to drop it, because to pursue it in detail would be to enter into the domain of some science whose limits are fixed, and to which further discussion properly belongs—for instance, we have a chapter on water (its composition and different states), which it might seem very desirable to pursue at greater length; but as soon as the student gets interested, without a word of warning the subject is dropped, and he finds himself introduced to the method of measuring angular space and time. This naturally leads on to some preliminary account of astronomy and astronomical methods, ending with the measurement of the day and year, and then, on turning the page, the reader is not allowed to continue the subject, but is invited to consider the composition and characteristics of common rocks. This incoherency is perhaps inseparable from the subject; but we think the author might have developed his introductory chapter at greater length and put his scheme and sequence of thought more fully before his reader, so as to prepare him for these sudden deviations from continuity.

It is instructive to notice that as educational treatises are improved in character and prepared by those qualified for the task, the reverent superstition which has for ages surrounded certain errors and fallacies, that have done duty for scientific reasoning, is being remorselessly swept away. The so-called proof of the sphericity of the earth, based upon the fact that ships have sailed round it, is not quoted now, even by incompetent teachers, with the same satisfactory conviction that was formerly accorded to it. Mr. Gregory gives a diagram which ought to convince the most antiquated schoolmistress, but such myths die hard. Similarly with our friend "the burning mountain," which has frequently been regarded as an adequate definition of a volcano—that too is meeting with its deserts; but this will take a still longer time to kill, let Prof. Judd and others insist as they will. Many instances will occur to every one who has compared the carefully compiled text-books of to-day with those that were popular only a few years back, and no fact marks more emphatically the improvement, or the necessity for improvement, in educational treatises. Definitions, to be accurate and adequate, will always be a source of trouble to the writers of elementary books, and the author of the present work has no doubt been exercised to combine the necessary accuracy and simplicity. We cannot think that he has always been happy, but where so much is admirable it would be ungrateful to dwell upon small blemishes, and can only be permitted with the view of securing their improvement or removal in a future edition.

The definition of meridian as given on page 105 and again at page 151 is susceptible of improvement, and it is certainly incorrect to describe a sidereal day as the interval of time that elapses between two successive transits of the same star. Such little slips must be due to the hurry of production, as that on page 382, where we are told to determine the position of the north point by observing the "shadow of the sun." We should have thought the shadow of the object would have been more convenient. And again, on page 407, what is meant by the sun's "regular diameter"? But such little slips as these do not materially detract from the merit of the book, which we heartily commend to the thoughtful study of those for whom it has been written.

SCIENCE AND BREWING.

A Handy Book for Brewers. By Herbert Edwards Wright, M A. (London: Crosby Lockwood and Son, 1892.)

THE author claims that the principal aim of this book is to give the conclusions of modern research in so far as they bear upon the practice of brewing. We gathered a different opinion on first opening the volume, for facing the title-page there stands conspicuously a trade advertisement of a firm manufacturing a patented article used by brewers, stating that this article is "referred to in the work," and "for further particulars see advertisement at end of book." To any one at all familiar with the way in which quasi-scientific articles are so frequently to be met with in the literature of brewing written for the purpose of advertizing their author or some other thing, it would be only natural to conclude that the advertisement quoted was the real clue to the origin of this volume, and wonder at the unusual clumsiness with which it was made so evident. However, we afterwards meet with the following statement in the author's preface: "Having found after the sheets had been finally passed to the printer, that the publishers considered it would be a useful feature in the book to insert a few advertisements of matters interesting to brewers, he wishes it to be clearly understood that he has no personal interest in the matter." A little prejudice perhaps remained in our mind even after reading this disclaimer, but in justice to the author we may say at once that a perusal of the book has removed it. We sympathize with him in having a publisher whose disinterested over-zeal for the convenience of his readers has given his book such an unpleasant first impression.

From a scientific point of view, in one respect the practice of brewing compares with the practice of medicine, in that the complexity of vital processes has to be encountered in both, and through our present imperfect state of knowledge of these questions, the practice of both is based very largely on empiricism. Fortunately for the brewer, the life functions with which he has to deal so largely belong to the more simple forms of life, and the vast strides which have been made the last few years in our knowledge of the microphytes, and the physiological processes of the higher plants, have probably placed him much nearer to a sound scientific basis on which to rest his practice, than is the physician who has to deal with the vital functions of the most highly developed organism. But even yet empiricism rules many details of the brewer's practice, although research is gradually throwing true light upon them; therefore any writer who, in the present state of things, attempts to bring scientific knowledge and the practice of brewing together, has a very hard task before him in order to clearly make his readers understand the relative position in which the two stand at present. Mr. Wright has with much diligence gathered together the results of a large amount of research work bearing upon the different stages of the brewing process, but we do not think that he has been always happy in selecting only the most trustworthy of these, neither are we pleased with the way in which he sets them before his readers to explain, or at any rate throw light upon, the different stages of the manufacturing process. It is a very difficult task, as we have just intimated, and we believe that the author, who is evidently a scientific man as well as a practical brewer, could have improved upon these parts of his work; at any rate we are quite sure that with due consideration he could easily have improved upon the general arrangement of his subjects, which is badly considered, and must be very confusing to a student not well acquainted with his subject.

We also regret that space is wasted in devoting a chapter to an attempt to teach the science of chemistry to the reader. Some such mistaken attempt is frequently made in technical works treated scientifically, but a greater waste of paper can hardly be imagined. For instance, in the present case we have a chapter starting with a description of the elements and the atomic theory, which positively, in less than thirty-five pages, professes to lead the reader up to the consideration of the con-

stitution of the carbo-hydrates and the amido-compounds. What can be the use of this sort of writing, however well done? No student not already well grounded in science generally can hope to get any real advantage from those parts of this book that are devoted to the scientific consideration of the details of the brewing process, and we wish the author had boldly recognized this very evident fact.

Apart, in a manner, from the more scientific portions of his book, the author gives us his views on the empirical questions of brewing, and also on the arrangement of a brewery and its plant, with the authority of much experience. Here is common ground on which all interested in brewing meet, and we recommend the author's conclusions as worth their attention. At the end of the volume we find a novel feature in a synoptic table of the malting and brewing processes, giving side by side the time, working memoranda, physical changes, and chemical changes of each process, an epitome which is likely to be useful to many readers. A good index also adds value to the book.

Although we do not think that the author in writing this book has been very successful in meeting the requirements of young students of brewing, yet there is a large amount of information contained in the 516 pages of the volume which will repay a careful perusal by those more advanced in the study of the scientific aspect and practice of brewing.

OUR BOOK SHELF.

A Manual of Veterinary Physiology. By Vety.-Captain F. Smith, M.R.C.V.S. (London: Baillière, Tindall, and Cox, 1892.)

THE publication of this work ought to delight the heart of the veterinary student, for hitherto in his pursuit of physiological knowledge he has been compelled to rely upon works which deal exclusively with the human subject. However excellent such works may be and well adapted to the requirements of the human physiologist, they must necessarily contain much which is only of secondary importance to the veterinary student, and absolutely nothing concerning many questions which to him are of vital interest. For example, how needful to him is a thorough knowledge of the physiology of the horse's foot—the seat, as he is afterwards to learn, of manifold diseases. Yet clearly the consideration of this subject is outside the range of human physiology. Similarly the composition, digestibility, and feeding properties of the foods supplied to the various domestic animals are to him matters of paramount importance. Yet here again he finds himself left in the lurch by the standard works on human physiology. Such considerations amply indicate the necessity for a work of the kind now before us, and cause us to wonder that the veterinary profession should have had to wait so long for its publication. Though several first-rate treatises on veterinary physiology exist in French and German literature, Captain Smith's is the first attempt, we believe, to deal with the subject in its entirety in this country.

We can heartily congratulate the author on the manner in which he has performed his task. He writes in a concise but precise style. Bearing in mind how many subjects the student is supposed to take up and master in a comparatively short time, the author has omitted, and we think wisely so, the details of physiological experimental methods and descriptions of elaborate mechanical appliances employed in the laboratory.

The value or usefulness of the horse depends so largely upon its powers of speed or draught that a knowledge of its locomotory apparatus is obviously imperative to the veterinarians. During recent years much light has been thrown upon the subject of animal locomotion by the elaborately devised experiments of Stillman and Muybridge, carried out, as is well known, by means of instantaneous photography. Captain Smith furnishes a capital *résumé* of the conclusions derived from these experiments and a number of plain, simple diagrams aid the reader considerably in comprehending the subject.

The physiology of the horse's foot is dealt with in a somewhat short chapter. The author adheres to the theory of the expansion of the foot at its posterior part when the weight of the body is imposed thereon. It is a subject which has often been hotly debated, and its discussion will probably be again reopened in the columns of the veterinary periodicals. The chapter concludes with some half-dozen rules on physiological shoeing, a copy of which might well be suspended and acted upon in every place where the shoeing of the horse is carried on.

The book is well printed, neatly bound, and published at a very reasonable price (10*s.* 6*d.*). Horse-owners as well as veterinarians will find its perusal attended with profit as well as interest. W. F. G.

The Principal Starches used as Food. By W. Griffiths. (Cirencester: Baily and Son, 1892.)

THIS little book of 62 pages will be found useful by analysts and others who are interested in the examination of foods. The author has collected together short descriptions dealing with the origin and microscopical characters of the different starches met with in commerce—the arrowroots, tapioca, sago, the starches of our common cereals, and of millet, maize, rice, the bean, the pea, the lentil, the potato, and so forth. These are classified according to the natural orders of the plants from which they are derived, and the descriptions are accompanied by remarkably good photo-micrographs, which indicate at a glance the peculiarities of the different varieties. The mode of classification serves to bring out the resemblances which often exist in starches obtained from plants of the same natural order. Since the microscope alone can be employed in attempting to trace the origin of a starch, and bearing in mind the extent to which it is now used as an adulterant, this handy little book will no doubt supply a want.

Three clerical errors were noted. On p. 47 "feint" should be "faint," and "not" is evidently omitted in line three from the bottom. On p. 48 "character" should be "characters."

Les Alpes Françaises. Par Albert Falsan (Bibliothèque Scientifique Contemporaine. (Paris: J. B. Baillière et Fils, 1893.)

WE cannot call this a successful book. A mixture of condensed statistical information and of popular descriptive writing is not much better than a stirabout of Liebig's extract and of trifle-whip. Fixity of purpose on the author's part is also wanting. Doubtless the French Alps cannot be separated from the rest of the chain, but for a book of only 286 pages all told, this contains too much about the Central, Pennine, and Eastern Alps. The geological part is sketchy, and not always very accurate. The author repeats the old mistake about the "variolite of the Durance forming a fringe to the euphotide," though the question was settled by the elaborate paper of Messrs. Cole and Gregory, published in the *Quarterly Journal* of the Geological Society for 1890. The illustrations are numerous; few, however, of them are good, and several very bad. There is no index. The work, in short, is a piece of book-making, characteristically French in style, and is not a valuable addition to the library either of the mountain-climber or of the man of science.

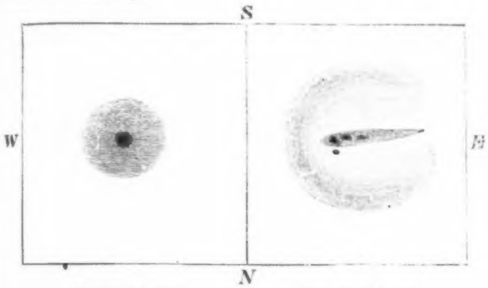
LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The New Comet.

THE comet discovered by Mr. Holmes on November 6 was observed here on November 9 at 5h. 50m., and found to consist of a very bright circular nebulosity with central condensation. The diameter of the comet was 5′ 41″.

It was re-observed on November 16 at 10h. 45m., and its physical appearance seemed to have undergone a complete transformation. The diameter had increased to 10′ 33″, and the cometary material had become much fainter and more irregular. The nucleus was now in the form of a bright streak, and this was enveloped in a large faint coma. A small star was seen just N. of the W. extremity of the nucleus, and the latter seemed composed of knots of nebulosity.



Nov. 9, 5h. 50m. Nov. 16, 10h. 45m.

On November 19, 14h. 15m., the comet was seen again. Its general aspect was much fainter, and it exhibited a further increase in dimensions. I carefully determined its diameter as 14′ 30″, but the outlying portions were very tenuous and indefinite.

From Berberich's elements given in Edinburgh circular No. 33, it appears that the comet is moving rapidly away from the earth. The great increase in its apparent diameter is therefore not a little remarkable. On November 9 the comet was about 203 millions of miles distant from the earth, and its real diameter must have been 333,000 miles. On the 16th this had increased to 652,000 miles. By the 19th the comet's distance had become 217 millions of miles, and its real diameter 925,000. In ten days, therefore, the cometary material expanded nearly threefold.

Bristol, November 20. W. F. DENNING.

The Light of Planets.

A FEW facts relative to this subject may be interesting. At Plymouth on August 12, about 9 o'clock, favoured with a beautifully clear horizon, the brilliancy of Mars was so great that it cast a distinctly black shadow on a piece of white paper from an ordinary walking stick held at a distance of 4½ inches; the outline of the hand, under the same conditions, was also easily perceptible. A faint, yet decided, darkening of the white cliffs of the shore was caused by a person standing upright—the slope being about 45°. The point of observation was at the extreme north-west of the Sound, and the splendour of the planet's light reflected from three or four miles of water is perhaps unrivalled.

The light of Jupiter has often enabled me, when using the telescope at a southern window, to make drawings and such references to books, &c., as were found necessary, without any other illumination. JOHN GARSTANG.

Springwell House, Blackburn, November 21.

Rutherfurd Measures of Stars about β Cygni.

IN order to prevent any possible misapprehension in connection with your notice (NATURE, vol. xlvi. p. 619) of Mr. Rutherfurd's measures of the stars surrounding β Cygni, may I call attention to the following?—The two stars of Argelander, 27.3435 and 28.334 concerning which a doubt is expressed in my paper, are certainly lacking on the Rutherfurd plates. If they were present they would be very near the edges of the plates, and it is for this reason that I doubted whether we should expect to find them at all. The star numbered 28 in the Rutherfurd list, which appeared only as a sort of elongation of No. 27 on a plate taken at this Observatory, April 19, 1892, is one of the components of Σ2539, as was pointed out by Mr. Burnham in the *Astronomical Journal*, No. 268, and by myself in the same journal, No. 266. HAROLD JACOBY.

Columbia College Observatory, New York, November 11.

The Alleged "Aggressive Mimicry" of *Volucellæ*.

MR. POULTON'S letter calls for few words in reply. I invited Mr. Poulton to produce observations in support of his statement that the two varieties of *Volucella bombylans* lay in the nests of the bees which they respectively resemble. To this invitation Mr. Poulton has not responded. He tells us that his account represented "a very general impression"; that the same impression has been set forth in a showcase at the Museum of the Royal College of Surgeons; that even if he were mistaken it was well, if through his mistake the truth shall the more abound. It is thus admitted that in making that statement Mr. Poulton relied not on original authorities, but on the general impressions of others. That these impressions are in any sense correct there is as yet no evidence to show.

Compared with this, Mr. Poulton's error as to *Bombus muscorum* is of course comparatively trifling and it would be useless to pursue the matter, were it not for discoveries made in the process of unravelling it.

I pointed out that *V. bombylans* is common in nests of *B. muscorum*, a bee which it does not resemble. Mr. Poulton in reply maintains the opinion that *V. bombylans* var. *mystacea* does resemble *B. muscorum*. In defence of this statement he refers to (1) the showcase at the Royal College of Surgeons, where the resemblance is set forth; (2) a recent book, "Animal Intelligence," by Mr. Lloyd Morgan, where the resemblance is again asserted and illustrated by figures of insects in the similar showcase at the Natural History Museum.

In following up these clues I came to unexpected results. (1) There is at the College of Surgeons a showcase, as stated, illustrating the likeness of *Volucellæ* to humble bees. The label states that "the resemblance enables them [the flies] to escape detection." Two bees are exhibited bearing a good likeness to the var. *mystacea*, and, as Mr. Poulton says, they are labelled "*B. muscorum.*" The one, however, is a worker of *B. sylvarum L.*, and the other is probably a male of the same species. Neither can be mistaken for *B. muscorum*, which they do not resemble.

(2) At the Natural History Museum bees of several species are shown beside the *Volucellæ*, with a similar statement that the resemblance enables the flies "to enter the nest of the bee without molestation." Not one of these bees is *B. muscorum*, nor are any of them said to belong to this species, for no names are given. Nevertheless, on turning to Mr. Lloyd Morgan's book, which I had not before seen, I find the statement (p. 90) that *V. bombylans* "closely resembles" *B. muscorum*, the passage continuing in the words of the Natural History Museum label. Figures are added showing the two forms of *V. bombylans* and two very different bees, *both* marked "*B. muscorum.*" Now the figures are from *photographs* of certain specimens in the showcase, and on reference to the specimens in question, it appears that one of them is a yellow-banded humble-bee (perhaps *B. hortorum*), while the other is one of the red-tailed humble-bees! These two are put out to match *V. bombylans* and the var. *mystacea* respectively, and of course have no likeness either to each other, or to *B. muscorum*, though both are referred to this species by Mr. Lloyd Morgan.

Mr. Poulton's choice of *B. muscorum* as a form resembled by the var. *mystacea* probably therefore arose from the wrong naming at the Royal College of Surgeons. How Mr. Lloyd Morgan came to call the two different bees by the name *B. muscorum*, which belongs to neither, I cannot tell. Perhaps this is in part an echo of Mr. Poulton's previous mistake.

Any one by reference to a collection of bees may easily satisfy himself that the common and ordinary *B. muscorum*, with its bright brown thorax, does not resemble *V. bombylans*, though this fly is common in its nests, just as *V. pellucens* lives in wasps' nests, though it does not resemble a wasp.

In the absence of direct evidence in its favour, and inasmuch

as it is inconsistent with many ascertained facts which were specified in my first letter, the hypothesis of "Aggressive Mimicry" should surely be withdrawn.

No speculation is needed to enhance the exceptionally interesting facts of the Variation and the resemblances of the *Volucellæ*. If a number of people will set to work on this problem in the way suggested, there is, I think, a fair chance of considerable results. It was in the hope that such effort may be made that I drew attention to the matter, and I am really sorry that Mr. Poulton should be hurt thereby. Nevertheless, I cannot but regard his account of the matter as an example of the way in which statements pass on from one writer to another, but prove on inquiry to be baseless. WILLIAM BATESON.

St. John's College, Cambridge, November 14.

Parasitism of *Volucella*.

MR. BATESON'S interesting discussion of the relations between *Volucella* and the species of *Bombus* (NATURE, vol. xlvi. p. 585) suggests the following observations:—The nest of *B. muscorum* is made without much effort at concealment on the surface of the ground. If accidentally disturbed the inmates set up a peevish buzzing, which, no doubt, answers the purpose of warning off ordinary intruders. Yet *B. muscorum* is of a patient and gentle disposition, and will put up with a good deal of maltreatment before using its sting. Its sting, moreover, is less venomous than that of either of our other common humble bees. It apparently trusts to the reputation of its genus for protection from annoyance. Such a creature would seem marked out by Nature as the very host to be imposed on by a parasite like *Volucella*, which, on the other hand, may need all its cunning to come round an irascible being like *B. lapidarius*, or even like *B. hortorum*. And, in fact, as Mr. Bateson points out, we find it multiplying abundantly at the expense of the first named bee, and less frequent in the nests of the other two. Notwithstanding this, *B. muscorum* appears to be certainly no less successful than either of the others in the struggle for existence. W. E. HART.

Falmore, Carrowmena, co. Donegal.

Optical Illusions.

THE illusion of the Gothic arch in NATURE (vol. xlvii. p. 31) is too good to have a rival, but simple Norman arches occasionally practise a deception of some subtlety. In certain cases they seem to be of the Moorish horse-shoe form; this happens when the semicircle does not spring at once from the capitals of the Norman columns, but has a short intervening vertical space of masonry. Architects are familiar with the effect, and call these arches stilted; they say the stilts are commonly vertical, although Norman walls have no doubt sometimes fallen away from the upright course. I suppose the eye is quick enough to perceive that there is more than a semicircle, while the mind is gullible enough to infer that the curvature is continued. In Winchester Cathedral there are some good illustrations of this appearance.

Winchester College, November 12. W. B. CROFT.

A Strange Commensalism—Sponge and Annelid.

A CURIOUS case of what I believe to be definite commensalism between members of these two classes came under my notice the other day when collecting, and, as it is, so far as I know, a new instance in this interesting inter-relationship between animals, I venture to record it.

Several large patches of crusting orange red sponge attracted my attention because of the peculiarly emphatic markings of what appeared to be the oscula. They were suspiciously unlike anything spongiform, so I secured some good pieces of the sponge for further investigation. Sections proved them to belong to the *Microciona plumosa* of Bowerbank, but the supposed oscula—which to the naked eye appeared as innumerable tiny black specks, each surrounded by a grey ring—proved to be, when the mass was teased out in water, in reality the ends of tubes inhabited by an eyeless *Leucodore* (*L. cæca*, Œrsted). Fully forty could frequently be counted in a square inch.

The conclusion I come to after examination of a large number of specimens is that actual benefit is mutually given and received by each of the two messmates; the sponge gaining considerable support and extra consistency from the numerous comparatively wiry upright tubes. There is also the question whether the excreta of the worms is of any food value to the sponge. On the part of the worm, there is little doubt that it finds a valuable protector in the sponge which by the way is characterized by an intensely rank smell of garlic (warning odour?). I have seen no signs of this sponge being preyed upon by any animal, so we may conclude its protective devices of spicules, odour or taste are fairly successful. A worm whose tube is sunk completely in its substance will naturally be very safely housed, and besides, the friendly water-currents set in motion by the sponge cilia will bring much food matter to its very mouth.

Bowerbank in his description ("Br. Spongiadæ," vol. ii. p. 134) writes of a specimen as "permeated by some small tubular zoophyte which it has coated with its own tissues, and from these adopted columns defensive spicula are projected"—evidently the same as I describe above, though he makes the mistake of considering the tubes as those of zoophytes instead of those of annelids. From this quotation, however, it is evident that the habit is widely spread, and not merely local. Here at extreme low-water the sponge grows exceedingly abundant, and the commensal worm seems always present.

JAMES HORNELL.

Jersey Biological Laboratory, November 10.

Induction and Deduction.

MR. DIXON says that there are "at least three different kinds of interpretation which may be put upon the proposition, [An isosceles triangle has equal angles at the base]. It may mean (1) the triangle used to illustrate this proposition has equal sides, therefore it has equal angles; or (2) I have conceived a triangle which has equal sides, therefore I have conceived one which has equal angles; or (3) the connotation ascribed by the adjective isosceles implies the connotation 'having equal sides' [? angles]."

He goes on to observe that the difference between either (1) or (2), and (3) is "that this latter gives us no information about any real thing or concept, but only about what is implied by using certain terms," that is, about the connotations of "isosceles" and "having equal angles" ("equal sides" is of course a slip). But if connotation refers neither to the attributes of "real things" nor to "concepts" (which I suppose means ideas or notions) what can it be that we "imply" by using the terms *isosceles*, &c.? If we do not mean things, nor attributes of things, nor ideas, do we mean anything which can convey or contain information?

In Mr. Dixon's view the terms do convey information, but information which "clearly does not require to be based upon any real knowledge of things, but may be based solely on definitions of words." But must not definitions of words be based, in the last resort, upon knowledge either of things or of concepts—definitions of current words in some current sense, or even of strange words in strange senses—as *e.g.* if I say Abracadabra means ixtra-mixtra, and Triangle means abracadabra, and all abracadabras are four-sided, and so on? With such propositions I may certainly frame syllogisms and arrive at "symbolical" conclusions, though I cannot see that I shall be doing anything to convey information or to advance thought.

And when Mr. Dixon says that the proposition "an isosceles triangle has two equal sides" has "wide applicability and usefulness" because we "often find things which can fairly be called isosceles triangles," it seems clear that he himself cannot have taken the proposition at starting in a sense purely "symbolic" (in his meaning of that word). If he did, it would be little less than miraculous that an entirely arbitrary definition should happen so to fit actual experience, especially when we consider that other equally symbolical mathematical propositions have an equal applicability.

I think it is probably true that we often do not depend, for our assent to complicated reasonings, on anything like full "realization in succession of the actuality of the relations and operations discussed"; but I cannot admit that such reasonings do not refer to objects of experience or of thought. Unless the terms did refer to something other than themselves, we could never assert *S is P*, or $x = y$.

I unfortunately know nothing either of Pascal's theorem or of the intersections of two conics; but I think that in the case of the individual isosceles triangle, my intuition that the equality of angles at the base is inseparably connected with equality of sides, gives me ample ground for believing it to be "mathematically certain" that every isosceles triangle has equal angles at the base; it is self-evident that the one characteristic cannot exist without the other. That the isosceles triangle in question, if put under a microscope or tested by some micrometer, might turn out to be not "really" isosceles, seems to be a perfectly

irrelevant consideration; and I have never been able to understand the stress laid upon it by acute thinkers. It is because the triangle is *as far as I can perceive* isosceles, that I intuit it to be *as far as I can perceive* equal-angled.

It has, I believe, been already explicitly recognized by certain logicians that a "symbolically" proved conclusion need not give any actual information about "real things." Indeed some go further; but I do not know that any have gone so far as to say that it would not give any information about ideas—although perhaps this may be the logical conclusion.

Cambridge, November 10. E. E. CONSTANCE JONES.

Ice Crystals.

YOUR correspondent, C. M. Irvine (vol. xlvii. p. 31) will find letters on this subject in NATURE, vol. xxxi. pp. 5, 81, 193, 264, 480, and in vol. xxxiii. pp. 461, 486.

Prof. (?) McGee's letter at p. 480, of vol. xxxi., gives a list of communications on the same subject in earlier volumes.

B. WOODD SMITH.

The Late Prof. Tennant on Magic Mirrors.

SEVERAL scientific friends tell me that the late Prof. Tennant, the well-known mineralogist, published some twenty or twenty-five years ago a small pamphlet on Magic Mirrors. Failing to find a copy even in the library of King's College, I invite the readers of NATURE to assist me to discover one.

SILVANUS P. THOMPSON.

City and Guilds Technical College, Finsbury, November 15.

On a Supposed Law of Metazoan Development.

UNDER the title of "The Relations of *Larvæ* to Adult Forms," I recently read a paper before Section D at the Edinburgh meeting of the British Association. The subject dealt with was of so extensive a nature, and the time available was so limited, that I fear much that was said must have appeared vague and ill-founded, if not entirely incomprehensible. The material of the essay had, indeed, been prepared with the intention of devoting at least an hour to its delivery: as it happened, I found myself under the necessity of cutting out whole passages of my notes whilst speaking.

The few lines of the report in NATURE (vol. xlvi. p. 404), convey a very inadequate idea of what I aimed at proving in the paper, and hence I am tempted to offer a fuller account to the readers of this journal.

The subject of the essay furnishes a problem which must interest every embryologist, even though he should reject the conclusions to which observation and reflection have led me.

In working out the complete paper so many novel and confirmatory points have been met with, so much of importance in the writings of the older embryologists, and more especially in the memoirs of Johannes Müller on the Echinoderm larvæ, has been unearthed, that an extension of the original plan of the work has been rendered necessary.

My conclusions, moreover, are so much in conflict with prevailing doctrines that any haste in producing the full argument would be unpardonable, although a preliminary sketch by way of clearing the ground may be justifiable. On a subsequent occasion an attempt would be made to show how the researches of recent years had, with a few notable exceptions (such as the work of R. S. Bergh, J. Kennel, and N. Kleinenberg), tended away from rather than in the direction of a recognition of the fundamental fact of an alternation of generations as underlying Metazoan development, in that they had been concerned, for example, with unnecessary attempts at homologizing the "mesoderm" and its mode of formation throughout the animal kingdom.

If the facts in support of my case should not be as complete as the published researches of the last thirty years on the ontogeny of very many animals might lead one to anticipate, the circumstance would have an obvious explanation.

With the death of Johannes Müller—a man whose brilliance as an embryologist was only surpassed by his greatness as an anatomist—there closed one chapter, and that one of the finest, in the history of comparative embryology. What influence the publication of "The Origin of Species" had upon the subsequent progress of the science is too well known to need further expatiation here. The pernicious search after pedigrees, initiated by Haeckel, led to an era of activity during which every fact with no apparent bearings on phylogeny was ignored. As a consequence the work of Müller on the Echinoderm larvæ and the essay of Steenstrup on "Alternation of Generations" became more or less mere curiosities in the history of the science. With little exception embryological speculation of the past thirty years has been naught else than a pursuit of will-o'-the-wisps.

It behoves us now to revert to the path along which Johannes Müller laboured.

My own embryological conclusions, like those of contemporaries, have not hitherto been influenced by the *embryological* works of Müller; for it was not until after my paper had been read that a first study of the Echinoderm memoirs convinced me how nearly he had anticipated what follows.

Before passing to the subject, one further remark may be permissible. Owing to lack of time when reading the paper, no opportunity offered itself for pointing out the analogy which obtains between the suggested mode of Metazoan development and the accepted fact of an alternation of generations in the life-histories of all plants above the lowest Thallophytes. Furthermore nothing was said about the mode of formation of the "mesoderm" in certain cases as one or more outgrowths of the endoderm; although the writer was fully alive to the explanation which from his standpoint could be offered. This and other questions of a like character would receive consideration in the complete paper, in which it would be demonstrated that such things and processes need be neither "palingenetic" nor "cœnogenetic," but that the analogy of the formation of imaginal discs in *Insecta*, or in the *Pilidium* of the Nemertine, ought to suffice to account for them. As an instance, the formation of the mesoblastic somites in Amphioxus as evaginations of the endoderm may be only a mode in which certain parts of the adult are in that particular case laid down upon the larva.

And now, after this digression, to return to the question under consideration. Two modes of development have long been distinguished, viz., *larval with metamorphosis* and *fœtal and direct*. Cases are known in which there subsists no homology between the larva and the adult, and even such in which the larva (*Bipinnaria asterigera*) is said to exist apart for a time after it has given rise to the Echinoderm. In many such, moreover, the sole larval organ carried over to the adult is the alimentary tract, all other organs of the larva, such as nervous system, sense organs, locomotor and excretory organs, mouth and anus, &c., being replaced by new formations in the adult. The new organs are thus not homologous with those of the larva; indeed, neither as a whole nor in its parts is the larva the homologue of the adult form; but the latter arises upon the former by a mode of asexual generation.

The birth of the Nemertine on the *Pilidium*, and that of the Echinoderm upon the *Pluteus*, or upon the *Bipinnaria asterigera*, may be cited as examples, and the question may now be asked, What becomes of the larva when (α) food-yolk is more or less abundantly acquired, and (β) when uterine development is initiated? Does the larva really disappear? Anticipating the sequel, it is asserted that the larva never vanishes from the development, but is always present in more or less disguised form. In all cases the adult or imago would appear to arise upon it just as is so obviously the case in the examples previously cited.

In the complete paper the modifications of the process throughout the Metazoa would be considered; in this place generalities alone can be dealt with. If the larva be laded with food-yolk it becomes transformed into a more or less obvious *blastoderm*, upon which the *imago* or mature form takes its origin. Certain of the larval organs—such as those of locomotion—may then disappear, but others, such as the larval excretory and nervous mechanisms (*e.g.*, *Hirudinea*, according to Bergh's researches, *Ichthyopsida* from my own work) would persist. Considerations of space do not permit me to enter fully into details regarding Molluscan development. The published work on this group furnishes one with useful material in support of my case; and the group is an interesting one in connection with this question of the relation of the larva to a blastoderm. In the *Mollusca* one can readily find all gradations from cases in which the adult is gradually substituted for a pelagic larva (*Patella*), through those in which the larva is somewhat burdened with food-yolk (*Buccinum*), to others, finally, in which there is a large yolk-sac and a blastoderm, on which the adult form arises (*Cephalopoda*). Incidentally I may remark that it was the study of some *Buccinum*

larvæ (*Veligers* with large yolk-sac) three years ago, which first afforded me a key to the solution of the problem of the relation of the larva to food-yolk.

The *Arthropoda* are an important group, for larval forms widely prevail, especially, as is generally admitted, in the lower forms.

The nature of the *Nauplius* is too big a question for discussion here, but Dohrn's conclusion that it is a transformed worm larva (*i.e.* one with *Arthropod* characters) appears to me to represent the truth. Two of the laws governing developmental processes appear to be that larval organs may be transferred to the service of the adult, and (more usually) that adult organs may become larval, or, as thay may be termed, *adaptational larval organs*. Numerous instances of both these could be cited, and the three pairs of appendages in the Nauplius furnish us with a case in point.

In the development of *Mysis* there is an example of the conversion of the *Nauplius* larva, typically represented in the allied *Euphansia*, into a blastoderm upon a yolk-sac.

I venture to attach most weight to the application of the principle to the *Vertebrata*, for it is there that my own work has chiefly lain, and it is undoubtedly the obstacles offered by the phenomena of Vertebrate development which have hitherto prevented the enunciation of the "law of development as an alternation of generations." Larvæ are so commonly encountered among the Invertebrata that the wonder is that no one has inquired why they are so rare, in any guise, in the *Vertebrata*.

In this latter division of the animal kingdom it becomes necessary to approach the problem previously stated as to the fate of the larva when uterine development is initiated.

It may firstly be noted that larval forms, equipped with many adaptational larval organs, are to be encountered in cases with complete segmentation and but little food-yolk, *e.g. Marsipobranchii*, *Ganoidei*, and most *Amphibia*, while a blastoderm on a yolk-sac is characteristic of *Elasmobranchii*, *Teleostii*, and *Sauropsida*, in which a larva, according to the common acceptation, would not be very obvious.

In all these cases, however, larval organs can be proved to exist, and, most important of all, there is a well-marked larval nervous system, which, while not certainly known to persist in any adult form, has been proved to degenerate during the ontogeny of all the oviparous *Ichthyopsida* as yet studied. This apparatus is certainly neither a part of the adult nervous system nor homologous with the latter. For an account of this mechanism the reader may be referred to the papers cited below.[1]

Among other larval structures referred to when reading the paper, the curious degenerating cells on the blastoderm of *Pristiurus*, to which Prof. Van Wijhe once drew my attention, and the knob on the blastoderm of *Torpedo*, as shown in Ziegler's beautiful models of the embryos of this form, and as described by H. E. and F. Ziegler in the *Archiv für Mikroscopische Anatomie*, Bd. xxxix. p. 85, deserve mention.

The yolk-sac viewed as part of the larva would require detailed and extended consideration.

It is gradually broken down by some ferment action on the part of the so-called merocytes,[2] which may possibly represent degenerating cells of the larva. Only towards the close of life in the egg-capsule does the yolk appear to be digested by the alimentary tract of the Elasmobranch. In some reptiles, according to Hans Virchow, the remains of the yolk-sac would appear to be cast off.

In the discussion on my paper, one speaker, a personal friend, hinted that I had been led to look upon the yolk-sac as part of the larva from having followed some stray ends of "larval nerve fibres" on to that structure. I had to confess my regrets that at that time I was unable to lay claim to any such observation; indeed, that having cut my embryos of *Raja batis* without any part of the yolk-sac appended, it had never occurred to me that the fibres described might pass to the yolk-sac. Quite recently it has been seen that at any rate some of the larval "subepiblastic nerves" of the *Anat. Anz.* paper *do undoubtedly make their way to the surface of the yolk sac, lying just beneath its epiblastic covering.* That a further confirmation of my conclusions is to be found in this observation goes without saying.

[1] J. Beard: "The Transient Ganglion Cells and their Nerves in *Raja batis*. *Anat. Anz.*, 1892, pp. 191–206; and also, "The Early Development of *Lepidosteus osseus*," Proc. Roy. Soc. London, vol. xlvi. 1889, pp. 115-118.

[2] It is to H. E. Ziegler that we owe most of our knowledge of the way in which these merocytes, in their own degeneration and death, cause the elements of the yolk to become fit for absorption and assimilation.

Some three years ago, when considering the "Inter-relationships of the Ichthyopsida," at a time when this larval question was prominently before me as a fascinating puzzle, I thought that the larva disappeared above the *Ichthyopsida*. I was led to this conclusion by reliance on the accepted belief that larvæ are only met with in aquatic animals, more particularly in marine forms, and by the apparent absence of a larval nervous system above the *Ichthyopsida*. My recent studies and the work of Froriep and Robinson have taught me that this was erroneous.

The larva never disappears, however much it may undergo degeneration.

It may even be doubted if there are not traces of the nervous system of the larva in the ontogeny of the *Amniota*, for there appear to be certain observations of Froriep on reptiles which may admit of interpretation in this sense, and my friend, Dr. Arthur Robinson, tells me that he believes he has found traces of it in certain Mammalian embryos. In mammals, as will be seen, the larva must be regarded as an internal parasite, and like such it would yield up its chief organs. Some remains of its nervous system may, however, persist, as I have proved to be the case in *Mustelus vulgaris*, where the larva is almost as parasitic as in the Mammal. The *Amnion* of the higher Vertebrata is probably also a larval structure with analogies to the organ of the same name in *Insecta*, in the *Pilidium* development, &c., as Kennel had previously insisted. It would appear to me to be a membrane conditioned by the way in which the adult is formed upon the larva.

Another important larval structure is the yolk-sac placenta of *Mustelus lævis* and of many mammals.

In the latter the importance of this organ during a long period of fœtal life has been proved by Hubrecht and Robinson.

The yolk-sac placenta may be explained as due to the fixation of a parasitic larva; indeed, in mammals the larva has become a fixed internal parasite in the uterus, and its mode of life, like that of all internal parasites, leads to great degeneration.

In this connection it may be insisted that it would be contrary to all that we know concerning the effects of the parasitic mode of life to suppose that a form might become a fixed internal parasite, and subsequently becoming freed from its host, attain to a higher grade of organization. Yet this is what we must believe to hold good, if the current views of mammalian development be accepted as correct. From my standpoint, on the contrary, the larva may become a fixed internal parasite, and none the less there may arise upon it a more highly organized and, when fully developed, free-living form, the Mammal.

Witness must be borne to the circumstance that Müller, Kleinenberg, and Kennel have already recognized that in some few divisions of the Invertebrata the mature form always arises upon a larva.

In such groups as the Echinoderms an alternation of generations is now an obvious explanation of the facts, and when so magnificent an investigator as Johannes Müller proved this nearly fifty years ago, one asks, in vain perhaps, why modern embryologists, like Korschelt and Heider in their otherwise admirable "Entwickelungsgeschichte," ignore it. The "recapitulation theory," and the question concerning the nature of the mesoderm have overshadowed the fact and concealed the recognition of an alternation of generations. But the so-called "law of ontogeny" itself is no explanation of the riddles of embryology; at most the recapitulation hypothesis holds for the development of organs, not of organisms.

So far as the facts are available, Metazoan development appears to me to be by means of an alternation of generations, in that from the fertilized egg there arises an organism, the larva, upon which, in one way or another according to the circumstances of each case, a new form, the adult or imago, takes its origin.

In 1855 the veteran zoologist, P. J. Van Beneden, wrote:— "*La génération alternante est un phénomène qu'il faut chercher à faire rentrer dans la loi commune de la reproduction et non pas laisser comme une exception dans la science.*"

In this essay an attempt has been made for the first time to prove that it is "la loi commune de la reproduction" in Metazoa,[1] and in concluding I cannot do better than echo the beautiful aphorism of Gœthe, which in a similar connection has already been commented upon by Steenstrup and Von Baer:—

"*Die Natur geht ihren Gang, und was uns als Ausnahme erscheint ist in der Regel.*"

J. BEARD.

[1] It is not assumed that all the phenomena classified as "alternations of generations" are alike in their nature.

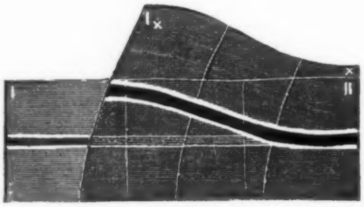
EXPERIMENTS ON FOLDING AND ON THE GENESIS OF MOUNTAIN RANGES.[1]

Method of Investigation; Folding at Different Levels.

DEFORMATION is represented in an exact manner, if we note the movements executed by certain points, and the position of these points before and after deformation. I divide the surface of sediments into squares (scale = 0·1m.), and this division passes in vertical direction through the whole system, so that every stratum is divided into prisms or cubes of known dimensions and positions. At every moment of deformation we may note the movements of any point or line, and the deformation of any square or prism. Especially the deformations of the surface and of normal-profiles is important. The position (orientation) of prisms must agree with the direction of pressure.

FIG. 1.

FIG. 2.



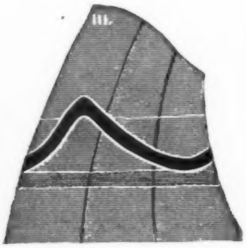


FIG. 3. FIG. 4.

FIG. 5. FIG. 6.

FIG. 7. FIG. 8.

I employed in every case muddy material (clay, plaster of Paris). Example: We note the position of prism I. in Fig. 1, and its position and deformation are noted in Fig. 2; I. is pushed forward and deformed into I.*x*. B = the "Basal plane," is parallel to the base or surface. No = Normal plane, is situated vertical and in the direction of pressure. L = Longitudinal plane, vertical and at right angles with No, agrees with extension of strata.

N = normals, *i.e.*, perpendicular scale-lines.

Explaining experiments: The sediments I., II., Fig. 3 (exp. 203, clay with a layer of plaster) are subjected to lateral thrust. The higher parts are more moveable and get deformed more than the lower strata.

I. goes to I.*x*, it is compressed and elevated; II. in contact with the wall is elevated a little (to *x*). The dark middle stratum I. produces a flat fold. In Fig. 4 compression and elevation is more intensive. The normals N (originally vertical lines) are deformed into curves.

When at the surface very plastic material dominates (mud), the surface after deformation remains flat, whereas in the deeper parts intense folding may have taken place. If we push a muddy mass, covered by plastic layers, the latter get folded, whereas the deep parts are only thickened.

The movements and deformations of N (normal profile) are of especial importance.

Fig. 5 (exp. 292), paper between muddy strata. The direction and deformation of normals show the typical movement of strata in each case.

In Fig. 6 a plastic layer (white) lies between muddy sediments. After the deformation only the white layer is folded.

In Fig. 7 folding towards the deeper parts is more intense, but the muddy surface remains flat. In all these cases strata get thickened. The thickness measured in a fold-chain does not correspond to the original thickness. The strata of the Appalachian Mts., having to-day a thickness of 10 km. in a certain section, originally had different dimensions. If measured along the fold-limbs the number is by far too small, as here the strata are rolled out; in the synclines, on the contrary, strata appear much thicker than they were at the beginning.

If plastic sediments are driven by their own weight, *i.e* if they *glide* over an inclined plane against an obstacle.

[1] Extracted from *Geologische und Geographische Experimente*, by Dr. E. Reyer. 1 Heft: Deformation und Gebirgsbildung. Leipzig, 1892. See also "On the Causes of the Deformation of the Earth's Crust," by the same Author. (NATURE, vol. xlvi. p. 224.)

there occurs a deformation, as in the case of lateral pressure. Deformation in the first case is greatest near the obstacle.

Anticlinal Rupture, Pinch-folds, Squeezing, Pseudo-eruptive Processes.

Pushing produces compression. In the anticlines tension effects rupture. In the fold-limbs plastic material is squeezed, rolled out, and pushed towards the clines (synclines or anticlines).

In the synclines of great dimension plastic material is pushed together and pinch-folds result.

Passing over some of the experiments which illustrate the dislocations described by Heim and Margerie we come to more complicated examples.

Figs. 5–8 show "pinch-folds" in very plastic material, which are spread and thrust over, so that they form a flat bottom in the syncline.

Other experiments illustrate a pinch-fold with ruptural deformation. Usually the intense deformation is confined to the district of the pinch-fold; in very plastic material and under variable pressure the stratum in every part gets greatly altered. If we divide the strata into differently coloured prisms we see in each profile at once the deformation at every point. Often deformation is so intense that we may denote it as kneading.

The deformation shows how a vertical dyke gets influenced by folding.

If a plastic stratum is inserted between rigid strata, the former often gets injected into ruptures of the rigid sediments; mud-dykes, pseudo-eruptive processes (Reyer, "Theoret. Geol." p. 330).

Movements of Normals and of Waves. Overthrust, Thrustplanes.[1]

In a fold-chain the higher masses are pushed over the lowland, which does not yield sufficiently. The result is an overthrust, often combined with pinch-folds, Fig. 11 (exp. 207). The inverted strata dip against the direction of the push.

Fig. 9 = original thickness of strata. In Fig. 10 folding begins. Fig. 16 last stage. Normal measure at the base = 1 dm.

In most cases shifting occurs between the strata, especially in upheaved strata, and we see gaping fractures, which cross a stratum and then follow again the planes of stratification (intrusive sheets).

The gliding movement may sometimes cause an extrusion.

Fig. 12 plan, and section Fig. 13 (exp. 278).

An overthrust-fold is nearly squeezed off (compare position of normals). An intense thrust generates ruptures, and the strata glide in the form of scales over the lowland.

Fig. 14 (exp. 242) a fault in the base, over which a complex of sediments glides; the lowland sinks and the higher masses now push with increased force towards the plain ("Vorfaltung": *Suess*).

Squeezing and Tearing, Deformation of Included Masses.

Squeezing and tearing often occur in regions of great difference of tension or pressure. In the anticlines strata are torn, the direction of ruptures is converging towards the axes (axipetal direction), in the limbs there occur squeezing and tearing.

[In the latter part of his memoir, Dr. Reyer shows how his experimental methods may be applied to the explanation of such complicated questions as very complicated overthrust faults, the appearances presented when much folded and faulted strata are subjected to erosion, the occurrence of undisturbed tracts associated with much folded ones, and the formation of lake-basins.]

E. REYER.

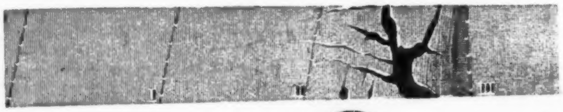
[1] Compare the excellent experiments of Forchhammer (Sanddruck, 1883), Cadell (NATURE, vol. xxxvii., p. 489). Those authors experimented with powdery material, whereas I operate upon plastic materials.

FIG. 9.

FIG. 10.

FIG. 11.

FIG. 12.



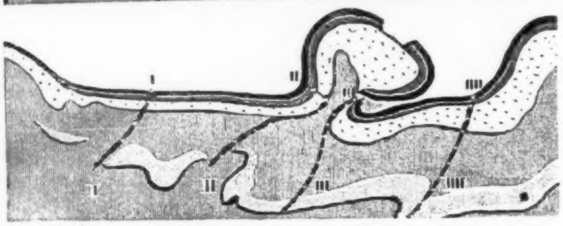


FIG. 13.

FIG. 14.

GALILEO GALILEI AND THE APPROACHING CELEBRATION AT PADUA.

ALTHOUGH Galileo began his career as a teacher in Pisa, and occupied for three years the Chair of Mathematics there, and was inscribed until his death in the list of the teachers of that University, nevertheless the University of Padua was the one to which from the beginning he had aspired, and in which he exercised with the greatest efficiency his powers as a man of science and

a lecturer. Now the University and citizens of Padua desire to celebrate the tercentenary of the day on which he delivered his first lecture.

When elected by the Venetian Republic to the Chair of Mathematics on September 26, 1592, he asked to be permitted to delay the beginning of his lectures in order to prepare his inaugural oration, and to attend to some domestic duties which required his presence in the country; thus it was December 7 when he first occupied the professorial chair. This date is confirmed by a letter, written from Padua to Tycho Brahe, and published by the latter in his celebrated "Astronomiæ Instauratæ Mechanica," and Galileo's chair is amongst the most precious relics preserved by the ancient and famous University. A week later he began regular lectures, which he continued to give for eighteen years.

In the ancient archives of the University the rolls of the time when Galileo taught are in a great measure preserved, and from these we learn that, in accordance with what was prescribed by the statutes, he alternated astronomical teaching with that of Euclid and the mechanical questions of Aristotle.

The didactic activity of Galileo was not altogether confined to public teaching; it was extended, in conformity with the prescriptions of the statutes, to private teaching. How much influence he exercised in this manner is easily seen from his autographic records which have come down to us. The importance of these private lessons will appear all the greater when we reflect that they dealt not only with the subjects discussed in public, but with matters connected therewith. From contemporary documents we perceive with what precision all such subjects were taught by Galileo: the use of the geometrical and military compass, fortifications, Euclid, perspective, mechanics, geography, arithmetic, geodesy, and cosmography. As to the students, they were for the most part foreigners, namely, Poles, Germans, Danes, French, and Flemings. In the lists of private scholars we find an "illustrious Englishman"—very probably Richard Willoughby, who was vicar of the University of Law and Councillor of the English nation. In his honour a stone on the wall of the University is still preserved, and, a still greater honour, a copy of the famous "Difesa" is dedicated to him with Galileo's autograph. Two Scots should also be particularly mentioned as amongst Galileo's pupils; these were John Wodderborn, who wrote a confutation of the libel of Horky against Galileo, and dedicated it to Henry Wotton, the English ambassador at Venice; also Thomas Segget, Councillor of the Scots nation, in whose "Album Amicorum," now in the Vatican library, there is also an autograph of the great philosopher. It was Seggett who received from Kepler a copy of Galileo's "Sidereus Nuncius," and who in the appendix to the "Narratio" of the same Kepler published the epigrams containing the famous "Vicisti Galilaee."

Besides the ordinary public and private lectures, Galileo held in the University some special public lectures, of which we may mention those upon the new star of October, 1604, and those in which he announced his astronomical discoveries.

Every one tried to render Galileo's stay in Padua as pleasant to him as possible. His freedom in teaching was absolutely complete, and the strong arm of the Venetian Republic defended the professors of the University from the power of Rome. In Padua, from the first, Galileo was received with the greatest kindness; he found many faithful friends both in Paduan society and among the Venetian patricians. His salary was repeatedly increased, so that, after the presentation of the telescope, it rose to thrice the amount conceded to his predecessors. Galileo came to Padua at the age of twenty-eight and remained there during the eighteen years which were the best of his life, those in which he showed the greatest scientific fertility, and in which he prepared the way for all his future labours. We have now reached the completion of the three centuries since Galileo began his teaching in Padua, and the University naturally considers that the anniversary should not be allowed to pass without honourable notice.

It is fitting that a celebration relating to the work of a man of science of the highest rank should have a truly national character. The King of Italy has therefore associated himself with the movement; and the Universities, the polytechnic institutions, and the most celebrated academies of the world have been invited to send delegates. Already the Universities have in great number responded to the appeal. Mr. J. Norman Lockyer will represent the Royal Society of London, and Mr. George Howard Darwin the University of Cambridge.

As once scholars from every part of Europe came to Padua to hear the celebrated master, so now from every part of Europe the most celebrated come to honour his memory.

ANTONIO FAVARO
(Director of the National Edition of Galileo's Works).

A NEW METHOD OF TREATMENT FOR CHOLERA.

IN the *Times* of the 18th inst. there appears an account of a new method of treatment for cholera which, should it ultimately be proved to be founded on accurate observation and well-authenticated cases, gives results seldom, if ever, obtained by any other method during the height of a cholera epidemic. Before criticizing this new method let us see what are its essential features.

In cholera there are two main, and evidently different, indications for treatment: it is usually maintained that the primary etiological factor in the disease is the "Comma" bacillus, which under certain conditions is enabled to live and multiply in the human intestine. There, living as an anærobic organism, it thrives especially well if, through inflammatory reaction, certain of the albuminous constituents of the blood and lymph are thrown into the intestinal tract. From or in this favourable culture medium it is enabled to produce a most virulent and readily diffusible poison, which has not only a powerful local action, but also a power common to these micro-organismal poisonous products, of acting on the nerve centres. In this way, so long as the bacillus remains alive, the supply of exudation into the intestine is kept up by the local irritant action of the poison, this being accompanied by a rapid abstraction from the blood of its watery elements, and at the same time a supply of the powerful "toxine" is maintained and diffused throughout the body. Except in very severe cases, where the paralyzing effect of the toxine on the individual cells of the tissues is extremely rapid and well marked, an effort is made by these cells to destroy the bacilli and by the special secretory cells of the intestine, kidney, and other excretory organs to eject this poison from the body. Not only so, but if the poison can, like the bacillus, be confined to, and eliminated directly from the intestine, the bacillus soon becomes unable to live, and as it multiplies and produces its toxines it is killed off by the various agencies that are conspiring to destroy it.

Up to the present all conceivable methods of treatment have been tried, and almost every drug has been pressed into the attack on cholera, but the most successful and rational attempts have been those in which the destruction of the bacillus and its poison have been aimed at, especially if this has been accompanied by the use of means for promoting the rapid secretion

and excretion of the poison from the body. Here as in the specific infective diseases generally our want is an antiseptic that will help to kill bacteria, directly or indirectly, and that will not damage, but will even give healthy stimulation to the tissue cells.

In this new method of treatment it appears to be claimed that in certain periodate salts we have substances which act not only on the bacillus (as bactericides) in the alimentary canal, but also directly on the "toxines," bringing about their oxidation into less complex and more stable non-poisonous substances, which can be readily excreted by the kidneys, or may be got rid of directly from the intestineal tract. It is also claimed, but apparently with very little reason, that the periodate salts have some direct action on the nerves; this, however, is mere conjecture, and the arguments offered in support of this hypothesis are far from convincing. In the *Times* article it is stated that "there are two principal drugs employed—the crystals of periodate" (of what?) "which are powdered, and a periodate of iron. The last-named is used in such cases as demand an extra strong nerve or cardiac stimulant treatment, and where there are severe neuralgic symptoms. The first is used in several ways: first as a powder to disinfect the alimentary tract; second as a plain water solution, prepared by boiling copiously, and used as a beverage by patients to wash out the stomach in severe vomiting, which abates as soon as the walls of the stomach begin to absorb the fluid, whereby the nervous energy is stimulated, in from two minutes to an hour or two; for transfusion under the skin, and, in cases of collapse, into a vein, for restoration of the suspended circulation of the blood; third, an acid solution of the powdered crystals of much greater strength than the plain watery preparation is found to stimulate the liver and kidney and gall bladder, promoting a free secretion of bile."

It is supposed that by this treatment the body is flushed and sweetened as it were, and so far the treatment would be rational enough could it be thoroughly carried out. Far greater reliance might have been placed on the evidence put forward had the initiator of this treatment been content to place on record facts, instead of attempting to formulate a theory for everything, as his theories whilst giving evidence of his undoubted enthusiasm, indicate only too plainly that where he gets beyond the use of the test tube he is compelled to draw largely on his imagination for many of his facts and most of his explanations.

As regards the percentage of recoveries mentioned, it must be remembered that towards the end of an epidemic the fatal cases always form a much smaller proportion of the total cases than during the earlier stages of the outbreak. The people most susceptible to the attack of the disease, *i.e.* those with damaged hearts, kidneys, and lungs, have already succumbed, the weaklings have been cleared out of the way, and but the fittest and comparatively well-nourished remain. Attempts have been made to ameliorate the wretched surroundings of those most prone to take the disease; the poor are better fed and better able to withstand the ravages of the cholera organism; the "cholera fright," at first a most potent factor in the preparation of patients for cholera, has to some extent subsided; the cases are not only much less numerous, but they are of a milder type and a less fatal character. Then, too, after the first few batches of patients come in (amongst which the mortality is always extremely high) there ensues a kind of panic amongst the authorities, and the treatment consists of little more than placing the patient in a ward along with others suffering from the same disease, in order to get them away from their healthy companions; other treatment is for long of the most meagre description, and it is only when hygienic conditions have been improved, mode of transport organized, and hospital accommodation arranged that the medical authorities have time to devote to the treatment of individual patients. As soon as patients do obtain such individual treatment and attention the percentage of fatal cases rapidly declines.

These periodates, analogous salts to the chlorates, are apparently the direct heirs to the qualities that at one time were ascribed to the chlorates, for which it was claimed that they had great power of supplying oxygen for the transformation of poisonous products in the body. It was found, however, that these chlorates when administered in large doses made their appearance in the secretions in a very slightly altered condition; not only so, but they exerted an exceedingly deleterious effect on the blood, reducing the hæmoglobin to methæmoglobin, and stopping the respiration and bringing about a fall of the blood pressure to zero. This periodate, which is apparently extremely insoluble except in acids, may be tolerated in small doses, but its physiological action, especially when administered in large doses, can scarcely yet have been studied.

As to the action on the kidneys through the nervous system, we have as yet little or no evidence that there is any direct action of the nerves on the secretion by the kidneys except through the vaso-motor system. It is usually maintained that the suppression of urine in cholera is due primarily to the extremely low general blood-pressure owing to the rapid abstraction of the fluid elements of the blood brought about by the passage of watery stools, but also in part to the irritative action on the secreting cells of the kidney of the cholera toxines, as a result of which secretion is more or less paralyzed. In order to overcome this stoppage of excretion by the kidneys, the practice of injecting warm normal saline solution has in recent epidemics been practised with some success, especially when boldly and repeatedly carried out. This treatment has the additional advantage that it not only supplies fluid to the parched tissues, but also increases the volume of blood on which the heart may contract and helps to wash away the specific poison. It is utilized to a very great extent in the new method described in the *Times*, but whether the periodates are better than common salt as a substance with which to raise the specific gravity of the warm water, yet remains to be determined. As yet the details supplied are far too meagre to allow of any definite opinion as to the value of this periodate treatment being arrived at.

It is fortunate that we have no cholera epidemic with us at present, otherwise we should have a right to complain that the *Times* has been made the medium through which what must be a very imperfect—and certainly from a physiological point of view—incorrect theory, has been presented to the public, and it will be well to await the exact accounts of those who have been entrusted with the carrying out of the treatment in the wards of the Seamen's Hospital, and the results of fuller chemical physiological, and therapeutic experiments, minutely detailed and recorded, before we allow ourselves to be buoyed up by hopes which, previous experience has taught us to fear, may be very summarily and completely dashed. We hope that we may have no opportunity of testing the value of this new treatment in England, but there is too much reason to fear that, abroa, opportunities in abundance will be afforded during net spring and summer.

How much of the success obtained in Hamburg is to be ascribed to the factors above mentioned, and how much to the careful treatment and nursing of confident medical men, inspired by the enthusiasm of the "inventor" or promoter of the "periodates," it is difficult to say, and we shall await with interest, but with well disciplined and chastened expectation, the report of the German doctors mentioned in the *Times* on the results of their observations.

NOTES.

MR. W. H. PREECE, F.R.S., has been appointed engineer-in-chief and electrician to the Post Office.

A CIVIL LIST pension of £75 per annum has been granted to Mrs. Dittmar, widow of Dr. William Dittmar, F.R.S., Professor of Chemistry in Anderson's College, Glasgow, in consideration of her husband's distinguished services.

THE Linnean Society, at its ordinary meeting on the 17th inst., adopted an address of congratulation to the Rev. Leonard Blomefield on the completion of the seventieth year of his Fellowship of the Society, he being the father of the Society, having joined it on November 19, 1822, and being now in the ninety-third year of his age. At the time when Mr. Blomefield (then Jenyns) became a Fellow of the Linnean Society, it was still under the presidency of its first President, Sir J. E. Smith; he was also an original Fellow of the Zoological Society, and is one of four survivors of the founders of the Entomological Society. He joined the British Association in the second year of its existence. Mr. Blomefield was Mr. Darwin's senior at Cambridge, was closely associated with him in his zoological researches until Mr. Darwin's death, and was one of his most frequent correspondents. His early bias towards the study of nature was due to his reading White's "Natural History of Selborne" while at Eton. This was then a very scarce book. Having borrowed a copy of it from a friend, being uncertain whether he should ever see it again, he copied the whole of it in manuscript with his own hand. The address of congratulation was moved by Sir William H. Flower, seconded by Mr. St. George Mivart, and acknowledged by the Rev. Geo. Henslow, a nephew of Mr. Blomefield.

THE following gentlemen have been appointed to form the Fishery Board for Scotland:—Mr. Peter Esslemont is Chairman, the other members being Mr. John Guthrie Smith, Sheriff of Aberdeen, Kincardine, and Banff; Mr. George H. Thoms, Sheriff of Caithness, Orkney, and Shetland; Mr. Dugald M'Kechnie, Sheriff of Argyle; Mr. William Boyd, solicitor, Peterhead; Mr. James Johnston, fish-curer, Montrose; Mr. William Anderson Smith, Ledaig; Professor Mackintosh, St. Andrews; and Mr. J. Ritchie Welch, St. Andrews.

THE Royal Microscopical Society will hold a *conversazione* in the Banqueting Saloon, St. James's Hall Restaurant, on Wednesday, November 30, at 8 p.m.

THE annual dinner of the Institution of Electrical Engineers was held on Friday evening at the Criterion. The president, Prof. W. E. Ayrton, F.R.S., was in the chair. Responding to the toast of the Learned Societies (proposed by the chairman in a humorous speech), Prof. G. F. Fitzgerald said that learned societies were never more flourishing than they were now. The co-operation of theory and practice had been the fruitful parent of nearly all the advances of the present generation. We had such enormous stores of energy at our service that almost immeasurable prospects were open for the material improvement of man's estate. Mr. Latimer Clark (past president) proposed "The Engineering Societies." He said these societies were in danger of being overlooked. They first perfected the steam-engine, then improved manufacturing implements, then the steam-boat. The engineering societies had done much more to promote the great prosperity of this country than the politicians who had so wickedly usurped the greater part of the credit. Dr. W. Anderson responded. The Chairman then proposed "Our Guests," with which he joined the name of Mr. Mundella, President of the Board of Trade, who exercised a sort of parental supervision over them all. No doubt sometimes there was a little disposition to grumble, as children did occasionally, at the form in which that fatherly affection displayed itself But, whatever their feelings about the Board of Trade, there was no doubt about their feelings with respect to its president. Mr. Mundella, in response, said that, whatever grievances the engineers might have against the politicians, his withers were unwrung. The Board of Trade might have given the electrical engineers some trouble: if so, it was not due to him. Mr. Latimer Clark had complained of the appropriation of all the credit of material progress by the politicians. Let them halve the difference. The politicians had, at all events, appointed Dr. Anderson. He was speaking to a comparatively young institution, but it was to one which was growing more and more and would advance to still greater degrees of greatness. The Board of Trade owed much to the electrical engineers, who had devised systems and methods of the utmost value He believed we were now at the outset of a great advance in the science of electric lighting. Progress would be assured when they could assure shareholders of a reasonable dividend. Two millions had already been expended in the metropolis, and we might soon hope to overtake the United States and Continental countries, which were, he feared, still to some extent in advance of ourselves. The Board of Trade had no desire to hamper the progress of electricity by needless rules, and hoped that in this, as in all other branches, science would go on its beneficent course untrammelled by any unnecessary regulations. Sir James Sivewright, Commissioner of Public Works, Cape Colony, proposed "The Institution of Electrical Engineers," to which the president briefly responded.

WE print elsewhere an abstract of a most interesting paper on stability and instability of viscous liquids, read before the Royal Society, by Mr. A. B. Basset. It presents in a new way the various problems involved in the calming effect of oil poured on troubled waters.

PROF. J. E. HUMPHREY, of the Massachusetts Agricultura Experiment Station, is about to visit Jamaica for the purpose of making a study of the algæ and fungi of that island.

THE weather during the past week has, upon the whole, considerably improved; it has been mostly fine in the southern and eastern parts of the kingdom, but less settled in the west and north. Temperature has been decidedly lower, and over the central and eastern parts of England sharp frosts have been experienced. The distribution of pressure has been generally cyclonic over these islands, but over the west of Europe the anticyclonic has still held its ground. The eastern portion of England has been brought under the influence of both high and low pressure systems, being situated about mid-way between the cyclones which have skirted our western coast, and the anticyclone over western Europe. These conditions were accompanied by very quiet weather, with a good deal of local fog. On Sunday a depression, which passed along the Irish coast, caused southerly gales on that and following days in the south of Ireland and the English Channel, with very heavy rainfall in Ireland; the amount measured at Roche's Point on Monday and Tuesday mornings was nearly 2·5 inches. Towards the close of the period the European anticyclone was spreading westwards, and the barometer was high and uniform over Great Britain. For the week ended the 19th instant the official reports show that the rainfall was considerably in excess of the average over Ireland and the south of England. From the beginning of the year the deficiency in the latter district is 2·3 inches, and in the south-west of England 8·4 inches, or more than 23 per cent. of the average amount. Bright sunshine was

again very deficient over the whole of England and Scotland; in the south-west of England the duration only reached about 2 per cent. of the possible amount.

THE *Pilot Chart* of the North Atlantic Ocean for November contains some interesting reports of the drift from some portion of the coast of the American continent to mid-ocean of a mass of forest growth resembling a floating island. It was first seen on July 28 in lat. 39° 42′ N., long. 64° 20′ W. On September 19 the *Roman Prince* reported it in lat. 45° 29′, long. 42° 39′ as "a clump of bamboos about 30 feet in diameter and 20 feet high." Between these two dates the little island drifted more than 1000 miles in an E.N.E. direction. The month of October was very stormy in the North Atlantic; from the tracks laid down on the chart several of the storms seem to have moved along very abnormal tracks, and this fact has probably some connection with the very severe weather experienced in this country. In the early part of the month a hurricane formed in very low latitudes, and passed over Trinidad on October 6 into the Gulf of Honduras, and possibly into the Gulf of Mexico. It is unusual for a hurricane to occur in such low latitudes in the North Atlantic. Very little fog was reported, and no ice south of the 50th parallel.

SEVERAL shocks of earthquake have been felt lately in the island of Ponza. On the evening of November 16, according to a Reuter's telegram, the walls of several houses were slightly cracked by one of these shocks, which was accompanied by subterranean rumblings. No one was hurt, but alarm spread rapidly among the inhabitants, half of whom took refuge on small vessels lying along the coast, while the remainder encamped on the beach.

THE *Age-Herald* of Birmingham, Alabama, gave on October 28 an account of a great meteor which had been seen on the previous day to pass over that city and disappear in a south-westerly direction. We learn from the Mobile *Daily Register* of October 29 that at Gadsden a brilliant meteor was seen at the same time, that is, between five and six o'clock on the afternoon of October 27. It passed near the zenith. Two young men employed in the *Daily Register* office at Mobile saw at the same hour in the afternoon a bright meteor in the north-west. It was about 45° above the horizon. When it neared the western horizon it exploded like a sky rocket.

A MALE gorilla (*Gorilla gina*) has lately been acquired by the Berlin Aquarium. He is larger than any gorilla that has yet been brought to Europe. He is supposed to be eight or nine years old, and was for six years in the possession of a chieftain on the Gaboon. Captain Clarke brought him to England. The *Naturwissenschaftliche Wochenschrift*—which estimates the value of this "splendid animal" as not less than 10,000 marks—says he has not yet shown any very friendly feeling for man.

IT appears from a report issued by the Board of Trade that the examinations and comparisons of the Parliamentary copies of the Imperial standards show that no measurable change has taken place in the length of the Imperial standard of measure. The Imperial standard pound weight appears, however, by comparison with the Parliamentary copies of the Imperial standard pound, to have decreased in weight since it was restored and legalized by the Standards Act of 1855. The amount of diminution in the weight of the Imperial standard pound would not be appreciable in trade, and had probably arisen before the year 1872, but the Board of Trade are taking into consideration the question of restoring this standard in the manner provided by Section 6 of the Act of 1878.

THE South Australian Government has issued a full report of the proceedings of the Rust in Wheat Conference during its third session, held in March of the present year. Among the resolutions adopted by the Conference was one to the effect that a practical system for the production and distribution of rust-resisting wheats suitable to different districts should be immediately established, and that this system—subject to modifications needed by each colony—should be conducted on the following lines:—A central station for each colony for the preliminary testing of new wheats introduced into the colony, for the production of new varieties by cross-fertilization and by selection, and for the distribution of suitable wheats thus obtained to representative districts of the colony, to be there subjected to a sufficient test, and, if necessary, fixed in their characters by farmers and others competent for the work, and that such wheats as pass satisfactorily this test should then be distributed to the farmers around in such a manner and by such agency as would be most suitable to the conditions of each colony. The Conference will meet at Brisbane in 1894. It is hoped that in the meantime the various colonies will publish the results of the experiments which are to be carried on during the coming year.

MR. XANTHUS SMITH, a well-known American photographer, has formed a high opinion of some of the work done in photography in England. "There is no doubt," he has lately said, "that the English photographers excel us Americans in landscape photography, and mainly for two reasons, the first being their appreciation of atmospheric effects, which is no doubt a result of their moist climate; and second, the extreme pains which they are willing to take in order to secure an effective picture." The *Photographic News* considers it "quite a comfort to record a statement like this, not because it praises English work, but because it acknowledges the pictorial effect often obtainable from a misty atmosphere." "Those who are ignorant of the subject," adds our contemporary, "invariably credit the alleged superiority of foreign photographs to the greater clearness of the atmosphere which is supposed to prevail outside the confines of Great Britain."

AN interesting case of a wild rabbit living in an almost tame condition is recorded by Helen J. Murray in the current number of *Nature Notes*, the Selborne Society's magazine. Mrs. Paul, a fisherman's wife, living in a hut between Ardnahein Farm and the mouth of Loch Goil, deserves the credit of having achieved this result. The rabbit was brought in when very young by a cat, and reared by Mrs. Paul, from whose hand it still feeds. It now spends part of its time in the woods, and part on the low sloping roof of the hut among the pigeons, or at the door among the fowls. It is shy in the presence of strangers, but quite friendly to the fisherman's wife.

IT seems that since the appearance of the Russians at Tashkend a beginning has been made there in the cultivation of the better kinds of tobacco. According to the *Journal of the Constantinople Chamber of Commerce*, quoted in the Board of Trade Journal, first trials were made by a commercial firm trading between Persia and China. The satisfactory result of this cultivation, due to the favourable atmospheric conditions and to the fruitful qualities of the soil, attracted many Russian imitators, and very soon the native population followed their example, so that the area of land devoted to the cultivation of tobacco now comprises sixty-three deciatines, and it is expected that it will not stop at that point.

THE new number of *L'Anthropologie* contains an interesting article by M. Emile Cartailhac, on the Stone Age in Egypt. It is the first of a series of papers on the stone age in Africa. English readers will be glad to see that in this instalment M. Cartailhac does ample justice to some of the discoveries of Mr. Flinders Petrie, the value of whose work has also been fully

recognized lately in the German periodical *Globus*. Another good paper in *L'Anthropologie*, by M. Louis Siret, deals with the end of the Neolithic epoch in Spain.

PROF. MCINTOSH'S paper on the Scottish Fisheries, to which we referred at the time it was read at the Edinburgh meeting of the British Association, has now been issued as a pamphlet by Messrs. John Leng and Co., Dundee. The paper presents a clear and interesting account of the Scottish Fisheries, chiefly in their scientific aspects, during the decade 1882-92.

THE Cartwright Lectures, 1892, delivered by Dr. Henry F. Osborn, Professor of Biology in Columbia College, have been reprinted from the *American Medical Record*. They deal with "present problems in evolution and heredity." In the first lecture Prof. Osborn discusses the contemporary evolution of man; in the second, difficulties in the heredity theory; in the third, heredity and the germ cells.

THE Kansas University has started a "Quarterly," which is to be maintained as a medium for the publication of the results of original research by members of the University. In the second number, which we have just received, Mr. E. H. S. Bailey has an interesting paper on the Great Spirit Spring Mound. The Great Spirit Spring is in Mitchell county, Kansas, on a conical limestone mound 42 feet high, and 150 feet in diameter at the top. The pool itself is a nearly circular lake about 50 feet in diameter, 35 feet deep, and the water rises to within a few inches of the top of the basin. There is a level space on all sides of the spring so wide that a carriage can be readily driven round it. Within about 200 feet of the mound is a limestone bluff, which rises perhaps 20 feet above the level of the spring. Mr. Bailey suggests that the mound may have been made by successive deposits from the spring. Although the mound is plainly stratified, this need not, he thinks, interfere with his theory, as the water may have been intermittent in its flow. The rock is very porous, and on being ground to a thin section is shown to be concretionary in structure. It is of just such a character as might have been built up by deposition from the water, as it contains the least soluble constituents of the water. The process of solidification would be assisted by the silica in the water, forming insoluble cementing silicates. An analysis given by Mr. Bailey shows that there is abundant silica in the water for this purpose.

A PAPER presenting a revision of the species of Coryphodon, by Charles Earle, printed originally in a Bulletin of the American Museum of Natural History (vol. iv., No. 1), has now been issued separately. The recent expedition sent out by the American Museum of Natural History to the Bad Lands of the Wahsatch formation of Wyoming was successful in procuring some valuable Coryphodon material. The entire collection was placed in Mr. Earle's hands for identification and study. He has been surprised by the large number of species which have been proposed, and finds upon studying and comparing the types that a great reduction in the number of species should be made.

WITH a view to determining the phylogenetic position of mammalian hair, Herr Maurer has recently been studying the sense organs of the skin, feathers, and hairs, and their mutual relations (*Morph. Jahrb.*). His researches render more evident the profound difference that exists, both in early development and in later behaviour, between mammalian hair and feathers. Morphologically, they are to be regarded as quite different organs. Are the hairs, then, *sui generis*, or may they be brought into relation with other epidermis-forms? From studying the lower vertebrates, Herr Maurer considers that the skin sense organs of amphibia afford the ground on which hairs are developed. The complex relations of the root sheath of the hair allow thus of an easy explanation. Further, as to the relation of mammalia to other vertebrate groups, as indicated by forms of integument, Herr Maurer is of opinion that mammals become separated from Sauropsida and draw closer to amphibians, thus confirming a view based on other points of organization.

FLUORSULPHONIC ACID, $SO_2(OH)F$, has been isolated by Prof. Thorpe and Mr. Walter Kirman in the laboratory of the Royal College of Science, South Kensington, and an account of their experiments was given at the opening meeting of the Chemical Society, held last Thursday evening. When liquid hydrogen fluoride is brought into contact with sulphur trioxide a violent reaction occurs. The product of this reaction, provided any great rise of temperature is prevented by extraneous cooling, is now shown to be fluorsulphonic acid, a liquid behaving in many respects like the chlorosulphonic acid, $SO_2(OH)Cl$, discovered by Prof. Williamson. The preparation of fluorsulphonic acid was effected in the following manner:—A quantity of sulphur trioxide was first distilled from a glass apparatus into the receiver of a distillation apparatus constructed entirely of platinum. A quantity of the anhydrous double fluoride of hydrogen and potassium, HF.KF, more than sufficient to furnish enough hydrogen fluoride to combine with all the sulphur trioxide, was then placed in the retort of the latter apparatus, and the retort connected with a long condensing tube surrounded by a freezing mixture of ice and crystallized calcium chloride. The receiver containing the sulphur trioxide was finally adjusted to the condensing tube, and was likewise surrounded by a similar freezing mixture. Upon heating the retort the double fluoride of hydrogen and potassium was dissociated, and pure hydrogen fluoride (hydrofluoric acid) distilled over into the receiver and reacted with the sulphur trioxide. The excess of hydrogen fluoride was subsequently removed by means of a current of dry carbon dioxide, the receiver and its contents being warmed to a temperature of about 30° during the process. The fluorsulphonic acid thus prepared is a colourless mobile liquid, which possesses an extraordinary affinity for water, reacting, in fact, with that liquid with almost explosive violence. It fumes when exposed to air, and possesses a specific mildly pungent odour quite different from that of hydrofluoric acid. It may be distilled, with but slight decomposition, in a platinum apparatus, its boiling point (corrected) being 162°·6. The latter constant was determined by use of a specially constructed platinum distillation apparatus, in the neck of the retort of which was fitted a small platinum tube containing a little mercury, and in which the thermometer was immersed during the process of distillation, in order to protect it from the powerfully corrosive action of the vapour. The error introduced by the use of this arrangement was very slight, and was determined by distilling liquids of known boiling points. Considerable interest is attached to the relatively high boiling point of fluorsulphonic acid, inasmuch as it is several degrees higher than that of chlorosulphonic acid, which boils at 155°·3. It would appear as if this fact is in some way connected with the relatively high boiling point of hydrogen fluoride itself (19°), as compared with that of hydrogen chloride, which, as most people are aware, is gaseous down to comparatively low temperatures. The main products of the decomposition which occurs to a slight extent during distillation, are most probably sulphuric acid and sulphuryl difluoride, SO_2F_2, which latter compound Prof. Thorpe and Mr. Kirman shortly hope to isolate by a method similar to that by which Behrend prepared the analogous sulphuryl dichloride, SO_2Cl_2.

THE additions to the Zoological Society's Gardens during the past week include two Maholi Galagos (*Galago maholi*) from South Africa, presented by Mr. Luscombe Searelle; a Feline Genet (*Genetta felina*), a White-eared Scops Owl (*Scops leucotis*), a Tawny Eagle (*Aquila naevioides*) from Matabeland, South

Africa, presented by Mr. B. B. Weil; two Jackdaws (*Corvus monedula*, white var.) British, presented by Mr. Harding Cox, F.Z.S.; eighteen Deadly Snakes (*Trigonocephalus atrox*) from Demerara, presented by Mr. J. J. Quelch, C.M.Z.S.; a Common Chameleon (*Chamæleon vulgaris*) from North Africa, presented by Mr. J. Pettitt; a Blue and Yellow Macaw (*Ara ararauna*) from South America, deposited; four Lapland Buntings (*Calcarius lapponicus*), twelve Snow Buntings (*Plectrophanes nivalis*) European, six Cirl Buntings (*Emberiza cirlus*) British, purchased.

OUR ASTRONOMICAL COLUMN.

THE NEW COMET.—The following observations of the "Comet Holmes" are communicated to the *Comptes rendus* by M. Bigourdan, Paris Observatory:—

Date.	Paris Mean Time. h. m. s.	App. R.A. h. m. s.	App. Decl. ° ′ ″
Nov. 9	7 59 25	0 45 55·51	+ 38 19 25·8
9	9 28 6	0 45 53·46	+ 38 19 4·5
13	10 20 1	0 44 3·76	+ 37 53 6·2
13	10 46 32	0 44 3·17	+ 37 52 58·7
13	10 55 43	0 44 3·01	+ 37 52 57·9
13	11 10 49	0 44 2·71	+ 37 52 50·6
13	11 25 6	0 44 2·33	+ 37 52 48·6

On November 9 the comet was a large and bright nebulosity, perfectly round, and 5′·5 in diameter. It showed a central diffused nucleus, 10″ in diameter. A rather brighter portion of an approximately elliptic form appeared to extend from the nucleus in the direction $p = 127°$, its axes being 1′·5 and 30″ respectively. On November 13 the comet was only seen intermittently. It was 8′ in diameter and nearly round. The nucleus no longer occupied the centre, but had shifted towards the preceding portion. The elliptical region was 2′ by 30″, and in the direction $p = 116°·8$. To the naked eye it was easily visible, being as bright as the Andromeda nebula near it, but less easily distinguished, owing to its smaller apparent size.

The most recent elements and ephemeris have been obtained from observations made on November 9 at Karlsruhe, November 10 at Rome, and November 11 at Göttingen, and are given in *Astronomiche Nachrichten*, No. 3128, from which we make the following extract:—

Elements.

T = 1892 August 15·779 M.T. Berlin.

$$\left.\begin{aligned} \omega &= 300°\ 2'·7 \\ \Omega &= \ \ 11\ 25·9 \\ i &= \ \ 27\ 34·0 \end{aligned}\right\}\ \text{M. Aequator, 1892·0}$$

$\log q = 9·92222$

Ephemeris for 12h. Berlin M. Time.

1892	α	δ	log r	log Δ
Nov. 17	0h. 43·5	+37 32	0·2562	9·9734
,, 21	43·7	11	0·2688	0·0071
,, 25	0 44·7	+36 50	0·2810	0·0387

The comet can be easily picked up with a small telescope by knowing that it lies in a line joining the stars β and θ Andromedæ, about one-third of the distance from β.

MOTION IN THE LINE OF SIGHT.—The transformation of the great reflector of the Paris Observatory for the purpose of adapting it to the spectroscopic determination of radial velocities is described by M. H. Deslandres (*Comptes rendus* 20). Instead of having a flat mirror at 45°, a collimator was placed in the optic axis itself, and movable along it. The rest of the spectroscope, which contained three flint prisms and a camera, was enclosed in a rigid steel box attached to the upper ring of the telescope. In order to control the motion, the plates forming the slit were made of polished steel and slightly inclined, so as to throw an image of the sky down into an auxiliary telescope inside the tube, which was provided with a reflecting eye-piece. Thus the observer below, standing near the great mirror, was enabled to keep the star well on the slit. With this arrangement, spectra of stars down to the 4th magnitude could be obtained, 12 cm. long, in two hours. In the blue portion a displacement of 0·005 mm. indicated a velocity of 3·6 km. per second. The lines whose displacements were measured were those of hydrogen, calcium, and iron. 250 stars are within reach of the instrument. For α Aurigæ, with a comparison of 30 lines, the velocity was + 43·5 km. β Aurigæ is a spectroscopic double with velocities, on February 5, of − 84 km. and + 97 km. Venus, on April 12, had an actual velocity of 13·55 km. That indicated by the negative was 15 km.

"HIMMEL UND ERDE" FOR NOVEMBER.—The current number of *Himmel und Erde* contains many astronomical articles of interest. "The Heat in August, 1892" is the subject of an article by Prof. W. J. van Bebber. In this he brings together all the statistics of the temperature readings during the interval between August 11 and 25, and shows by weather charts the general state of the weather, such as wind, barometer, &c. The following few values, showing the highest temperatures recorded and extracted from the table mentioned above, may be of interest:—

Place.	Aug.	Temp. Fahr.	Place.	Aug.	Temp. Fahr.
London	23	80°·6	Cassel	17	96°8
Oxford	23	77·0	Grünberg	19	102·2
York	23	73·4	Karlsruhe	17	96·8
St. Petersburg	26	86·0	Bamberg	18	100·4
Stockholm	26	82·4	Constantinople	21	100·4
Paris	18	95·0	Madrid	16	107·6
Biarritz	16	107·6	,,	17	107·6
,,	17	104·0	Rome	17—21	93·2
Brussel	18	95·0	Lagouat	23	105·8

Dr. J. Scheiner, on "Astronomy of the Invisible," deals with the discovery of the dark companions of Sirius and Procyon. He commences with an historical sketch of the study of the proper motions of the fixed stars and leads up to the most modern observations describing the results obtained with regard to Sirius and Procyon. Prof. Barnard, with the help of two excellent woodcuts, explains the working of the great Lick refractor. To prepare the instrument for micrometric work, he says five minutes is required; but for photographic work ten minutes is necessary, as a photographic correcting lens has to be adjusted to compensate for the difference between the photographic and optical focus; the large spectroscope absorbs nearly half an hour's work before it is ready for observation.

OBSERVATIONS OF PERSEIDS.—During the August display of the Perseids it has been noticed that in addition to the principal radiant point several minor ones have been observed, which although not very far distant from the primary one, are still far enough to suggest that they belong to another swarm of particles following a different track in space. The orbit, which the particles in the main follow, corresponds, as is well known, to that of the comet of 1862 III., and M. Bredikhine has suggested that the particles producing these minor radiant points belong really to the same swarm, only have either been acted on by external forces such as the perturbations of the major planets, or have been projected from the comet itself at different periods.

With the intention of bringing some facts to bear upon this idea, M. Puiseux, in the *Bulletin Astronomique* for October, gives the results of his observations made in August of last year, which seem to confirm those of M. Bredikhine in several points of view.

His method of observation was simply to chart down on a large celestial globe the positions of the trails as observed. A glance at this globe, after 199 positions had been so recorded, indicated that the area of radiation occupied a considerable surface, and extended principally in the directions of right ascensions, that several distinct centres of concentration were observable, and that the same radiant points, in general, manifested their activity at the same time, *i.e.*, on the evenings of August 10, 11, and 12, and some on August 7. In the table accompanying this paper M. Puiseux shows that no less than fourteen different centres of radiation were observed. Table II., which we produce here, contains the essence of the whole work, and shows the positions of the radiant points in question, together with the corresponding elements of the orbits deduced. It must be remembered of course that their values cannot be very accurate, owing to the difficulty of observation, but the results are nevertheless interesting. The different radiant points are denoted by A, B, C, &c., while α and δ represent

their right ascension and declinations; the other nomenclature is that usually adopted in cometary computations.

	α	δ	l	b	☊	i	q	ω
A	44°·5	49°·1	57°·1	30°·7	138°·6	127°·3	0·9643	296°·2
B	41·3	46·7	53·8	29·1	138·0	130·3	0·9836	302·3
C	47·3	39·7	56·0	21·2	139·0	143·6	0·9674	297·8
D	62·7	60·6	73·2	38·7	138·5	107·1	0·8046	265·6
E	52·5	53·4	64·3	33·2	138·1	120·6	0·8839	277·9
F	35·3	65·8	60·0	47·9	138·7	99·1	0·9759	298·9
G	30·0	43·4	44·0	29·1	138·4	130·7	0·9982	330·3
H	105·3	60·9	99·4	38·0	138·7	79·1	0·5145	230·2
K	19·5	28·4	29·0	18·6	138·7	144·3	0·7495	19·2
L	5·3	67·0	45·8	56·1	138·6	87·9	1·0028	322·3
M	118·5	53·2	109·6	31·7	138·7	64·0	0·3811	215·0
N	314·7	67·4	23·4	72·9	137·9	62·4	0·9872	330·8
O	323·5	50·1	355·0	58·8	138·7	63·1	0·8402	5·7
P	14·0	37·4	28·5	28·7	138·5	126·3	0·8046	11·9

GEOGRAPHICAL NOTES.

THE Royal Geographical Society has determined on a change in the form and alteration in the title of its *Proceedings*, which will materially enhance the value of the monthly publication. The size of each part will be increased to ninety-six pages, and two volumes will be published in the year instead of one as formerly. Internally the arrangement will be slightly altered, and while the strictly geographical character of the publication will be maintained, the notes and record of geographical work from other countries will be made at once more systematic and more popular. A special feature will be the record of the "Geographical Literature" of the month, summarizing all the accessions to the library, both books and memoirs. This will form a subject-index to geographical literature, and serve as a continuous appendix to the exhaustive subject-catalogue of the Society's library which is now being compiled. The editorship of the new series remains in the hands of Mr. J. Scott Keltie, the assistant secretary.

WITH reference to the note on the death of Lieutenant Schwatka, the Alaskan explorer, published last week, we are glad to observe that an official enquiry negatived the theory of suicide, and showed that the fatal result followed from an overdose of morphia taken medicinally.

THE German colonial authorities have recently come to a very important decision as to the official spelling of the place names of their various protectorates in Africa and New Guinea. European names are to retain their ordinary form, but all native names are to be rendered phonetically according to a new set of rules. These rules so closely resemble those put forward by the Royal Geographical Society, and now widely used, that it appears possible by some slight concessions on both sides to make one set serve both for English and German. The letters *c*, *q*, *x*, and *z* are dispensed with as redundant, *c* and *z* being rendered by *ts*, *x* by *ks*, and *q* by *kw*. The guttural *ch* becomes *kh*, the English *ch* being given as *tsh*, and the sound of the English *j* as *dj*. The German *j* sound will be represented by *y*, and the letter *j* used only for the French sound, which is represented in English as *zh*. The German sound of *w* is rendered as *v*, the letter *w* being kept for the English sound. Unfortunately the letter *s* is kept for its soft German sound, the sharp sound of the English letter being shown by *ŝ*. The use of the English *z* would have overcome this difficulty, and removed the most serious obstacle to a common orthography.

CAPTAIN MONTEIL, whose arrival at Kano on his way to Lake Chad was referred to in May last (vol. xlvi. p. 110), has at last been heard of, and his mission, although involving two years of travel in the Sudan and Sahara, appears to be successfully completed. The facts could not be put more concisely than in Monteil's official telegram to the French Foreign Office, which arrived on November 15:—"October 17. To-day I entered the territory of Fezzan by way of Tejerri coming from Kuka. Having set out from Kano on February 19, I reached Kuka on April 10, where the reception was excellent. I left Kuka on August 15 with a guide, sent by the Sheikh to accompany me to Murzuk . . . . which I expect to reach on or about the 25th, and to stay there just long enough to arrange my departure for Tripoli. Badaire has borne the journey exceedingly well. My men are all with me, except two left at Kuka." This is the most important journey through the Central Sudan and Sahara since the classical explorations of Barth and Rohlfs.

STROMBOLI IN 1891.[1]

STROMBOLI is one of the most noted but least studied of volcanoes. The regularity of the weak explosions which, succeeding each other at intervals of a few minutes, characterize its normal state, gives rise to the idea that its action is always thus uniform and monotonous, and the occasional paroxysms to which it is subject are apt to be overlooked. In reality the so-called Strombolian phase of volcanic activity differs from the Plinian phase exhibited by Vesuvius and certain other volcanoes merely by the absence of intervals of perfect repose between the violent outbursts which are characteristic of the latter type. It is in this difference that the explanation of the fact is to be found, that from time immemorial no explosion in any way comparable to the great explosions of Vesuvius have occurred at Stromboli; for the ceaseless activity of the latter prevents the accumulation of sufficient force to produce a powerful and destructive effect. But from time to time the throat of the volcano does get more or less choked, and the efforts of the imprisoned vapour to escape result in an eruptive phase of some violence. Such an event took place during the latter months of last year, and the following description of the phenomena is based on the observations of Profs. Ricco and Mercalli, and of Ing. Arcidiacono.

The state of the volcano preceding this outburst had been one of relative calm for two years. In October, 1888, an explosion had opened three new mouths on the upper edge of the Sciara del Fuoco, from one of which lava was emitted. This was the commencement of a period of increased activity, with repeated issue of lava, lasting nine months till June, 1889. From this date to the eruption of last year, and particularly during the six months just preceding, the activity was less than normal. It is to be noticed, however, that there were two short intervals of recrudescence, lasting only a few days, at the end of December, 1890, and January, 1891.

On June 24, 1891, at 12.45 p.m., two strong earthquake shocks were felt over the whole island at an interval of a few seconds. Loud rumblings and a violent explosion followed each. The shocks were not confined to the island of Stromboli, but were felt at Salina, a distance of 40 kilometres. Even the subterranean rumblings were heard at the latter island. The first shock and the first explosion were, as might be expected, more violent than any which succeeded. Windows were broken at the semaphore station, and a great precipice of rock fell into the sea at the Filo del Cane, and other rocks in the same locality were so loosened that they fell on following days. Two powerful columns of ash, like thick smoke, arose from the crater and ascended far above the summit of the island. Great masses of scoria were ejected and fell toward the northern part of the island, burning the grass and fig-trees. A boat passing to the north-east of the island at the time of the first explosion could not see the semaphore signals, owing to the quantity of ash in the atmosphere. Lapilli fell around the eruptive mouths for a radius of a kilometre and a half, and a fine, dark grey ash rained over the whole island. A stream of lava issued from a point on the Sciara del Fuoco near to the most western mouth, and a deep fissure formed its upper rim nearly in the same place as that of November, 1882. For two days the lava continued to flow, and loud explosions were frequent. The rumblings were almost continuous. On the 26th the emission of ash ceased, but moderately vigorous outbursts occurred with the ejection of incandescent scoria till the 27th; but on the 28th and 29th the volcano had resumed its wonted calm. On the 30th, however, a fresh earthquake, accompanied by rumblings and a violent explosion, showed that the volcanic forces were not yet spent. An immense column of vapour and incandescent materials arose from a new breach on the edge of the Sciara, while an abundant current of lava flowed down the slope reaching the sea at its foot. The whole of the powerful explosions of the 30th were repeated at short intervals, but the activity

[1] Sopra il Periodo eruttivo dello Stromboli cominciato il 24 giugno, 1891. Relazione dei Prof. A. Ricco e G. Mercalli col Appendice dell' Ingegnere Arcidiacono. ("Annali dell' Ufficio Centrali Meteorologico e Geodinamico" [2] XI. Pt. 3, 1892.)

gradually declined till July 4, when its normal state was reached. The eruptions were again violent, with emission of lava from the 16th to the 23rd of July.

The mouths on the edge of the Sciara, which were contemporaneously active during the above period, were four in number—two at the northern end and two at the western end. One of the former pair was opened by the explosion of June 30, and from it was ejected the greater part of the detrital material of the eruption, so that around it a cone has been built up, truncated by a crater, sub-elliptic in form, of about 60 metres in maximum diameter. The height of this new cone above the old edge of the Sciara is about 50 metres. The other crater is situated on the deep fissure mentioned above, and at night, from the sea the incandescent lava could be seen in free communication with the atmosphere—a circumstance which explains the fact that the explosions from this crater were rare and of feeble intensity. The two western ones were situated one below the other with an interval of about 30 metres. Near the lowest, three large fumaroles gave forth dense columns of steam, while other lesser fumaroles were plentifully scattered about. The majority of the explosions took place from these two mouths. During this same period, lava was emitted three times, (1) on June 24, soon after the first two explosions from the most western part of the Sciara; (2) on June 30, from the crater on the fissure; (3) on July 16, from the central part of the Sciara, between the first two. They all reached the sea, and since the second stream doubled itself round an obstacle about half way in its course, four new points were formed on the shore. The thickness of the lava at these points varied from 4 to 6 metres. Specimens of the lava collected from the most western stream showed that it consisted of an almost homogeneous blackish-brown paste, compact in the interior, but becoming more and more porous and reddish in colour towards the exterior. Some of the larger cavities were internally covered with a shining brown patina. Externally it was covered with a rough crust, reddish-brown in colour, and of scoriaceous aspect. It was sensibly attracted by the magnet, and melted without effervescence to a brownish-green glass. Crystals of plagioclase, augite and olivine were apparent. In section, about two-thirds was rendered opaque and black by very minute microlitic granules of magnetite which were intimately mixed with a transparent glassy base, colourless or inclining to greenish. The remaining third consisted of a great number of colourless transparent microlites of plagioclase. Fluidal structure was only just apparent. In this microlitic paste were scattered crystals of plagioclase, augite, and olivine. The augites were greenish in section and possessed a feeble pleochroism. The olivines were corroded and irregularly fractured.

Analysis gave the following numbers :—

	Stromboli.	Etna. Mean of analyses of 20 modern lavas.
Silica	50·71	49·45
Alumina ...	13·99	19·30
Ferric oxide	5·13	11·82
Ferrous oxide	9·10	
Manganous oxide	·42	—
Lime	10·81	10·21
Magnesia ...	4·06	3·69
Potash ...	3·02	1·33
Soda	2·87	3·58
Loss on ignition	·24	—
Cl and SO_2	(traces)	—
	100·35	99·38

The lava is similar to other lavas of Stromboli, and to show the great similarity between the lavas of Stromboli and Etna, the mean of the numbers of twenty analyses of modern Etna lavas is appended for comparison.

The scoria, lapilli, and ash of the eruption present no special features, but are what might be expected from a lava of the above composition.

Although the volcano had reached a state of comparative calm at the end of July, this did not last for very long. Towards the end of August fresh signs of activity gave warning of an approaching explosion, which took place on August 31. It was preceded by an earthquake a few seconds before, and as a result a vast column of ash rose above the volcano, while scoria and other projectiles were shot out to a considerable distance. Soon after, a fine ash, dark red in colour (instead of black as in June-July), fell over the island, covering the ground in some places to a depth of several centimetres. On the evening of September 1 dense columns of ash were again emitted, and in the afternoon of September 3 the whole crater was enveloped in a thick mantle of steam, in the midst of which could be dimly seen a reddish-grey column of ash rising with extraordinary violence to a great height, when it spread out into a volcanic "pine." A fresh stream of lava was also observed. Eruptions succeeded each other at short intervals, accompanied by continuous rumblings, interrupted now and again by loud explosions, like heavy artillery. As far as could be observed, on the western side of the crater was a single mouth of almost circular form, 10 metres in diameter, which was most active in sending up vast columns of ash and projectiles of all kinds. To the east could be seen one or more little mouths, which tranquilly emitted large volumes of steam, while in the midst a large aperture, 30 metres in diameter, irregular in form and deeply fissured, was in powerful action. The activity, however, gradually quieted down, and towards the end of the year the volcano resumed its normal state.

In conclusion, it is useful to compare this eruptive phase of Stromboli with other contemporaneous seismo-volcanic phenomena of the Italian peninsula. It appears that earthquakes occurred in various districts in the early months of 1891, especially one on June 7 in the Verona district, rather severe, occasioning loss of life. Vesuvius was rather more active than usual during the whole of June, and in correspondence with this the great fumarole of the solfatara at Pozzuoli, increased in temperature. It is particularly interesting to note that Vulcano, the other active volcano of the Lipari Islands, remained in perfect calm during the whole period, emitting only vapour from the fumaroles. As, however, the character of the eruptions and the lithological composition of the material ejected from this volcano differ so greatly from those of Stromboli, it is tolerably certain that there is no free and direct communication between the reservoirs of these two volcanoes. In fact, Stromboli presents a much greater analogy with Etna. The similarity of the lithological composition of the lavas of these two volcanoes has already been referred to, and, further, Prof. Mercalli observes that the last four or five eruptions of Etna have all been immediately preceded or followed by a paroxysm at Stromboli. It is thus possible that there is a real relation between them.

L. W. Fulcher.

A LARGE METEORITE FROM WESTERN AUSTRALIA.

In the *Mineralogical Magazine and Journal of the Mineralogical Society* of July, 1887 (vol. vii.) Mr. L. Fletcher, M.A., F.R.S., president of the Society, describes four specimens of a new meteoric iron found at Youndegin in Western Australia. They were discovered about three-quarters of a mile to the north-west from the top of Penkarring Rock, in the above district, about seventy miles from York. These fragments were found by Alfred Eaton, a mounted police constable, when on duty in the district of Youndegin, when he brought in one of the four pieces he found on January 5, 1884. Mr. Fletcher states that the late Mr. Edward T. Hardman, F.G.S., the then Government geologist, expressed his belief in the meteoric origin of these iron masses. Later the above-named Alfred Eaton was sent with a native assistant with instructions to bring in the other three pieces, and at the same time an unsuccessful search was made for additional fragments. In the above account it is stated that the four pieces were lying loose on the surface, three of them close together, and the fourth fifteen feet away. They weighed respectively $25\frac{3}{4}$ lbs., 24 lbs., $17\frac{1}{2}$ lbs., and 6 lbs., the largest and smallest fragments are now in the British Museum collection, and the specimen of 24 lbs. is in the Geological Museum at Freemantle, and the fourth piece, weighing $17\frac{1}{2}$ lbs., was presented to the Melbourne Museum in Victoria.

The new specimen now in my possession was discovered last year, and weighs $382\frac{1}{2}$ lbs., and measures $22\frac{3}{8}$ inches high, $20\frac{1}{2}$ inches wide, and $13\frac{1}{4}$ inches in its greatest thickness. In form it is roughly convex on one side and concave on the other, on both sides of which are large depressions or pittings similar to those usually observed on other large masses of meteoric iron. It is somewhat triangular in outline, but with irregular sides. It has one small hole quite through the mass near the top, and numerous deep holes, one near the bottom left-hand corner

having a diameter of about $1\frac{1}{2}$ inches and 4 inches deep; another at the opposite bottom corner 2 inches deep and 2 inches in diameter; also another of 3 inches deep, and several others. On the upper edge especially, and at several other parts near, also on the edges, are fractured surfaces, as if in its fall a mass or masses were broken off, leaving a coarse crystalline structure, and which would indicate that several other large holes having existed before its fall on the earth, probably all or most of the pieces were connected together, and might have fallen in one mass. It would be interesting to know if any of the pieces fitted together at the fractured surfaces as seems to me might be detach a fragment of which the cut face was not $2\frac{1}{2}$ inche square.

Mr. Fletcher also states that on treating a specimen of this Youndegin iron to the action of bromine water, or of dilute nitric acid, the polished section gave no definite figures, but assumed a damascened appearance very like the Tucuman iron and of that of Brazos, being very similar to the latter in the proportion and distribution of the Schreibersite; some specimens of the Arva, the Sarepta, and the recently found Canon Diablo are similar as exhibiting these characters.

One-fifth natural size.

possible. I observe that the two specimens of this iron in the British Museum collection exhibit similar fractures on the edges. Before receiving this specimen I was informed that two masses were found, but have no information at present as to the size and weight of the other.

Mr. Fletcher in his paper minutely describes the size and form of the two British Museum specimens, and that the specific quantity was determined from three small pieces from the larger specimen, and gave 7·86, 7·85, and 7·72. He also states that a portion was cut off the larger piece by means of hack-saws, and was found to be so hard that three weeks were required to

The Youndegin iron was also remarkable in containing the minute cubic and modified cubic crystals, having metallic lustre and of a greyish black colour, and which were determined to be graphitic in character, but of a diamond-like form; but were later found to be still distinct from the diamond, but having somewhat more the features of graphite. Mr. Fletcher therefore decided to give the name of Cliftonite to this substance, as being a new form of a carbon mineral. A most exhaustive description of this new mineral is given in his paper. Similar crystals of this substance are found in one or two other meteoric irons.

The composition of the Youndegin iron was found to be as follows:—

Iron	92·67
Nickel	6·46
Cobalt	0·55
Copper	trace
Magnesium	0·42
Phosphorus	0·24
Sulphur	none
Insoluble cubes	0·04
	100·38

JAMES R. GREGORY.

THE CROSS-STRIPING OF MUSCLE.

PROF. RICHARD EWALD of Strassburg, has just communicated a paper to the fifty-second volume of the *Archiv. f. d. ges. Physiol.*, in which he confirms Prof. Haycraft's views concerning the structure of striped muscle. The latter observer has held for many years that muscle fibrils are varicose threads, and that the cross-striping is but an optical appearance due to this varicosity. The varicosity is often difficult to demonstrate in the ordinary way, and most histologists were not prepared to admit that the stripings are all and entirely due to it. Prof. Haycraft, however, recently brought forward to the Royal Society of London, and to the Berlin International Medical Congress, fresh and striking proof of the strength of his position, by demonstrating films of moist collodion, on which pieces of muscle had been pressed and then withdrawn. As a result of this pressure the collodion films were stamped as with a seal, and the impressions revealed in striking detail every stripe of the original fibre. Prof. Ewald confirms these experiments in the fullest manner, but suggests that the collodion impressions might be produced on the assumption that there are layers of hard and soft material alternating with each other in the course of the fibrils. In this case the hard material would press into the collodion and make a series of furrows, which would appear as a series of stripes when examined with the microscope. Prof. Haycraft had previously demonstrated the varicosity of the fibrils, seen by transmitted light, and had published photographs of his preparations, but Prof. Ewald was still sceptical upon this particular point, and sought to assure himself still more conclusively. With this end in view he examined muscle, which had been rendered quite opaque, by means of reflected light, for under these circumstances the influence of the internal structure would be entirely set on one side, and the surface of the fibrils would alone receive and reflect the illuminating rays. For purposes of illumination Prof. Ewald used the apparatus of W. and H. Seibert, of Wetzler, by means of which vertical rays can be projected upon an opaque object; and he rendered his preparations, both of fresh and of hardened muscle, quite opaque by a method of over-silvering. Under these conditions Prof. Ewald found that the cross-striping is most distinct, and he was able, with his admirable method of illumination, to examine the surface of a muscle just as one may observe the surface of the country at night by means of a search-light from an observatory. With the light perfectly vertical the tops of the ridges of the muscle are bright, and the valleys on either side in half-light. By shifting the light to one side or to another the slopes of the ridges can be thrown alternately into shadow or bright light. Prof. Ewald concludes by admitting that his experiments fully prove that the striping is due to the shape of the fibrils alone, and that the internal structure of the muscle plays no part in its production.

IRIDESCENT COLOURS.[1]

ON taking a general survey of coloured objects, whether natural or artificial, we become aware of the fact that whilst the colours of some remain unchanged as regards tint, whatever their position in relation to the incident light, the tint of others varies with every alteration in their relationship to such light source. We thus see that so far as their colours are concerned all bodies may be arranged in two groups according as their colours change or do not change in tint as their angular relationship to the light varies. Nor is this classification entirely an artificial one, since, as will shortly be seen, though this change in tint with variation in the light source is an essential difference, it is not the only difference, even in the colour manifestations of the two groups, for it is also characteristic of the nature of the colour-producing structure. It is to the above-mentioned varying colours that we apply the term iridescent, from the resemblance they have in the sequence or play of colours to the tints of the rainbow. The unvarying group of colours, having no equivalent term to "iridescence" to express the nature of their colour production, are spoken of as "pigmentary," or absorption colours. In naming examples of objects, natural and artificial, grouped as above in accordance with the nature of their colours, it is difficult to make a selection where all are so varied and characteristic. I have preferred therefore to cite only such instances as I myself possess, and am therefore able to show you. As examples of pigmentary colours, I need only name one or two for the sake of comparison, since the colours of most objects ordinarily met with are pigmentary. Leaves, flowers, dyes, birds, fish, insects, minerals, &c., exhibit these colours, some almost entirely, and all, excepting fish, in far the majority of instances. Of objects displaying iridescent colours we have also examples in the various divisions of the animal, vegetable, and mineral kingdoms. Amongst birds the most striking examples are found amongst the humming birds, sun birds, birds of paradise, &c. Insects, again, furnish numerous examples, more especially amongst tropical species, though not, perhaps proportionally in greater numbers than amongst those belonging to our own more temperate regions. The colours of fish are almost entirely iridescent, since their very whiteness, or silvery sheen, is due to the admixture of the iridescent colours of innumerable minute thin lamellæ, too small to be seen individually with the naked eye, but plainly perceptible under the microscope. In the vegetable kingdom iridescent colours are far more numerous than is ordinarily recognized, since the surfaces of the cell walls produce interference colours which are more or less obscured by the pigmentary colours of leaves and coloured flowers, but may be readily seen in the case of white flowers by the aid of a lens and sunlight. Under these conditions each cell may be seen to sparkle with its own iridescent colour, forming, by admixture of the interference tints of neighbouring cells, the varying shades of white seen in numerous flowers which are devoid of pigmentary colour. Mineral bodies displaying iridescent colours are also numerous; opals, sunstone, fire-marble, felspar, mica films, tarnish on various metallic crystals, certain crystals of chlorate of potash, &c., are examples.

In describing the various natural objects for purposes of identification, or mere description, no account can be considered complete which omits all reference to their colours, and more especially is this the case where the colours constitute such a striking feature, as in the case of iridescent bodies. In innumerable instances, more especially amongst birds and insects, their specific names are taken from some conspicuous colour they possess. It thus becomes evident that a correct description of the colours of bodies is of importance, and where these colours are of the pigmentary, or unchanging kind, this is a matter of no difficulty. How different, however, in the case of objects, the colours of which not only vary with every change of position, but disappear altogether, unless viewed with special relation to the light source. Nor can it be wondered at that descriptions of these objects, even by observers of undoubted repute, vary according to the different angles from which they have been viewed; or are vague and profuse, owing to fruitless attempts to describe their changing tints produced by every movement. The fact is, no words can convey an adequate impression of the gorgeous effects produced by most of such objects, whether birds, insects, or fish, when in motion in brilliant sunshine. Some notion of the difficulties to contend with in describing the colours of humming birds, for example, may be gathered from the remarks of Wallace in his work on "Tropical Nature," when speaking of humming birds:—"In some species they must be looked at from above, in others from below; in some from the front, in others from behind, in order to catch the full glow of the metallic lustre; hence, when the birds are seen in their native haunts, the colours come and go and change with their motion, so as to produce a startling and

[1] By Alex. Hodgkinson, M.B., B.Sc. Reprinted from the fifth volume of the fourth series of "Memoirs and Proceedings of the Manchester Literary and Philosophical Society." Session 1891-92.

beautiful effect." Most observers, in describing the colours of iridescent bodies, do so by attempting to depict the varied effects produced by casually changing the position of the object in relation to the light, omitting to mention the exact *sequence* of the play of colours, or the relation of these colours to the direction of the iridescent light, *i.e.*, whether produced by perpendicular or oblique illumination. Here is a description of the tufted neck humming bird, *Trochilus ornatus*, taken haphazard from a well-known work :—"The throat is of a fine green colour, variable in different lights to a golden hue with a yellow or brown metallic lustre, and below that the whole of the belly is a rich brown, glossed with green, and golden." Such descriptions as the above, which happen to be the first I met with in seeking for an instance, are vague, and fail to give a definite idea of the appearance of the object. But vagueness in the description of these objects is not the only result of the changing character of their colours. As might be expected, where such variation in appearance exists the descriptions of different authors are almost as variable as the colours. Few attempt descriptions without acknowledging the hopelessness of the task. Thus Jardine, after describing this humming bird, *Chryslampis mosquitus*, remarks :—"It is impossible to convey by words the idea of these tints, and having mentioned those substances to which they approach nearest, imagination must be left to conceive the rest." And I adduce this quotation as fairly expressing the feeling of naturalists in reference to the description of iridescent objects generally. Recognizing the admitted inability of observers to convey by description an idea of the appearance of these iridescent objects, and having myself, for many years, constantly experienced the same difficulty, I have been led to adopt a method for the examination of such objects, which, whilst extremely simple and available in its application, yields unvarying results with different observers, results, moreover, which admit of the simplest description.

Before describing this method, I may say that long experience in the examination of iridescent objects has proved to me that, almost without exception, the colours of natural iridescent objects are due to interference produced by thin plates. In order, therefore, to render clear the principles on which the method I propose is founded, I will briefly refer to certain fundamental facts in connection with colour production by thin plates, and for this purpose will select a thin film of mica, which with light at perpendicular incidence, appears red, iridescent red. If, now, this plate be inclined so that the light falls on it at a more oblique angle, it is, of course, reflected at the same angle, and now appears orange, and if the plate be still further inclined, the reflected light appears yellow, then yellowish green, green, and bluish green, and if the light were not too copiously reflected from the first surface to allow of perceptible interference by further inclination of the plate, all the colours of the spectrum in their proper sequence might be observed. The same results, but much more vividly, may be seen in these crystals of chlorate of potash. Thus, we see that by rendering the incident light more and more oblique, the reflected light changes from a lower to a higher tint, that is, from the red towards the violet end of the spectrum. And this is what occurs in the case of all iridescent bodies, as the incident light becomes more oblique the colour changes to the tint above it in the spectral order, so that, if we know what colour any such object appears when seen at a certain angle, we can infer what colour it will change to on varying the incidence. This beetle (*Sagra purpurea*), for instance, is red at perpendicular incidence, it will, therefore, appear orange yellow and green when examined by successively increased obliquity of light. And the same is true of all other iridescent red objects. If the object at perpendicular incidence be green, as in the case of this beetle (*Bupristis*), it will become blue and then violet as the incidence is increased. We thus see that an iridescent object varies in colour, simply because it is examined by light incident, and therefore reflected, at different angles. Thus, different observers see the same iridescent object of a different colour, when they view it illuminated by light at a different angle of incidence. If, however, the object is seen by all at the same angle of the incident light it will present the same colour, and this is, in fact, what the method I propose ensures, *i.e.*, that iridescent objects shall always be seen by light at one and the same angle of incidence. The angle I select is one of 90, so that the incidence and reflection are normal or perpendicular to the reflecting surface. By selecting this angle all trouble of measuring angles is avoided, since we know that the incidence is perpendicular when it coincides with reflection. Now, the reflected light may be made to coincide with the incident light by reflecting it on to the object by means of a mirror, and so adjusting the object that the light reflected from it passes to the eye through a perforation in the mirror. When examined in this way iridescent objects are marvellously altered in appearance, their changing colours are replaced by one fixed tint, visible only in one position, a fact which serves at once to distinguish them from bodies coloured by absorption, which remain coloured whatever the relation to the incident light. Such methods of examining bodies scarcely takes more time than by the eye alone. The mirror may be attached to a spectacle frame so as to leave both hands free, such as the one I show, or may be a simple hand mirror. For objects too small to be seen by the unaided eye, I have so arranged the microscope that light is made to pass down the tube of the instrument, through the object glass on to the objects, and by a special arrangement, so adjusted the position of the object that the light is reflected back again through the instrument to the eye. The method is thus available for macroscopic as well as microscopic objects.

To illustrate the practical value of this plan of examination, I have here a few objects exhibiting iridescent colours, which, by trial, will be found to give the following results :—

The crest of this humming bird, *Chrysolampis mosquitus*, which, to the unaided eye, appears resplendent with all shades of red, orange, yellow, or green, according to the angle of the incident light, appears, when examined by the mirror, of one unvarying red tint, disappearing when the object is moved but absolutely unchanging in tint. Such an object, therefore, I should describe as "iridescent red"; all else regarding its colour may be inferred. Again, the breast, or gorget, of the same bird reflects all shades of orange, yellow, or green to the eye alone; with the mirror it is seen of a deep orange, which, as before, is unchanged in tints by any variation in position. Such an object I would describe as "iridescent orange." The gorget of another humming bird, *Calliphlox amethystina*, to the eye alone appears crimson, orange, yellow, or green: with the mirror it is iridescent crimson only, spectroscopically a red of the 2nd order. Amongst insects, instances of iridescent species are numberless, the results of examination are just the same as in other iridescent bodies. This butterfly, *Morpho*, to the eye alone appears either greenish-blue, blue, or violet, as its inclination to the light varies; examined with the mirror it appears green, and should be described as iridescent green, or iridescent bluish-green. This beetle, *Poropleura bacca*, appears any shade of red, yellow, or green to the eye alone; with the mirror only iridescent red. In this extraordinary beetle, *Chrysochroa fulminans*, we have all the colours of the spectrum in their natural sequence, beginning with red at the tip of the wing case, and ending with violet higher up the elytron. These colours vary in an indescribable manner when attentively examined at different angles of incident light with the eye alone; with the mirror the wing cases are seen to be coloured successively from base to tip iridescent green, yellow, orange, and red, and these tints remain unaltered by change of position of the object. This piece of *Haliotis* shell exhibits indescribable changes of colour with every movement, but the difficulty of description, though by no means removed, is immeasurably lessened by the use of the mirror. And the same with this specimen of iridescent iron ore, its colours, which vary to the unaided eye, remain unchanged when examined by the mirror. To simplify the description of iridescent objects, therefore, I would advocate the above method, and would describe the result of such examination by recording the colour observed by aid of the mirror, and prefixing the term "iridescent" to express the changing properties of the colour. Bearing in mind the unvarying nature of these changes, a far clearer idea may be formed of the appearance of these objects than from any attempted description of what is admittedly indescribable. Time and space are also economized by the omission of lengthy descriptions. The accuracy, and, therefore, the value of any description of colour, is always enhanced by mapping its spectrum; more especially is this true in the case of iridescent colours. This is easily done, and by applying such map to a spectral chart, the order of the colour, and therefore its tint, is apparent. In examining many objects, chiefly birds or insects, by means of the mirror as above described, apparent exceptions are repeatedly met with to the fact stated above, that the colour

is invariable in tint and disappears by inclination of the body. Such instances are no real exceptions, but are due to the reflecting plates being curved, or having pigmentary matter beneath them, or an opalescent medium above them. In this way some of the most extraordinary and beautiful colour effects it seems possible to conceive are produced.

In examining objects with the perforated mirror a single light is necessary. The sun is of course the best, and the electric light probably almost as good. I frequently employ the lime-light, but a good paraffin lamp may be used as a substitute. Ordinary gas is unsuitable. The light should be placed in front of the observer, its direct rays being prevented from falling on the objects by means of a book or partition of some kind resting on the table, and of such a height that the light can be seen above it. On placing the mirror to the eye the light may be reflected from the mirror on to the object, and the latter manipulated so as to reflect the ray back through the perforation in the mirror to the eye. The incidence is thus known to be normal, and the colour observed is the one to be recorded.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following letter has been addressed by the University of Cambridge to that of Padua, which is about to celebrate the tercentenary of Galileo's professorship :—

Universitas Cantabrigiensis Universitati Patavinae S.P.D.

Litteras vestras, viri doctissimi, GALILAEI GALILAEI Professoris vestri celeberrimi in laudem conscriptas vixdum nuper perlegeramus, cum statim in mentes nostras rediit non una Italiae regio viri tanti cum memoria in perpetuum consociata. Etenim nostro quoque e numero nonnulli urbem eius natalem plus quam semel invisimus, ubi Pisano in templo lucernam pensilem temporis intervallis aequis ultro citroque moveri adhuc iuvenis animadvertit ; etiam Vallombrosae nemora pererravimus, ubi antea scholarum in umbra litteris antiquis animum puerilem imbuerat ; ipsa in Roma ecclesiam illam Florentinam intravimus, ubi doctrinae suae de telluris motu veritatem fato iniquo abiurare est coactus ; Florentiae denique clivos suburbanos praeterivimus, ubi provecta aetate caeli nocturni sidera solus contemplabatur, ubi extrema in senectute diei lumine orbatus cum MILTONO nostro collocutus est, ubi eodem demum in anno mortalitatem explevit, quo NEWTONUS noster lucem diei primum suspexit.

Hodie vero ante omnia non sine singulari voluptate sedem quandam doctrinae insignem, intra colles Euganeos urbemque olim maris dominam positam recordamur, ubi trecentos abhinc annos saeculi sui ARCHIMEDES discipulorum ex omni Europae parte confluentium numero ingenti erudiendo vitam suam maturam maxima cum laude dedicavit ; ubi, ut LIVII vestri verbis paulum mutatis utamur, ultra colles camposque et flumen et assuetam oculis vestris regionem late prospiciens, caelo in eodem, sub quo vosmet ipsi nati estis et educati, instrumento novo adhibito inter rerum naturae miracula primus omnium Lunae faciem accuratius exploravit, Iovis satellites quattuor primus detexit, Saturni speciem tergeminam primus observavit, ultraque mundi orbem ingentem a Saturno lustratum fore suspicatus est ut etiam alii planetae aliquando invenirentur.

Ergo vatis tam veracis, auguris tam providi in honorem, nos certe, qui Professorum nostrorum in ordine planetae etiam Saturno magis remoti ex inventoribus alterum non sine superbia nuper numerabamus, hodie alterum ex Astronomiae Professoribus nostris, Georgium DARWIN, nominis magni heredem, nostrum omnium legatum, quasi Nuntium nostrum Sidereum, ad vosmet ipsos libenter mittimus. Vobis autem omnibus idcirco gratulamur quod tum Italiae totius, tum vestrae praesertim tutelae tradita est viri tanti gloria, qui divino quodam ingenio praeditus rerum naturae in provincia non una ultra terminos prius notos scientiae humanae imperium propagavit quique caeli altitudines immensas perscrutatus mundi spatia ampliora gentibus patefecit. Valete.

Datum Cantabrigiae
a. d. viii *Kal. Decembres*
A. S. MDCCCXCII.

Mr. F. Darwin has been appointed Deputy Professor of Botany for the current academical year, Prof. Babington being unable to lecture on account of the state of his health.

SCIENTIFIC SERIALS.

American Journal of Science, November.—Unity of the glacial epoch, by G. Frederick Wright. An examination of the evidence in favour of two successive glacial epochs separated by an inter-glacial epoch, during which the glaciated area was as free from ice as it is at the present time. This evidence is shown to be inconclusive, at least as far as American observations go.—A photographic method of mapping the magnetic field, by Charles B. Thwing. Iron filings are strewn upon the film side of a dry plate laid horizontally in a magnetic field, and the plate is exposed to light from above. The filings are then brushed off, and the plate developed. From the negatives excellent lantern slides may be obtained.—Contributions to mineralogy, No. 54, by F. A. Genth, with crystallographic notes by S. L. Penfield. Description and analysis of aguilarite, metacinnabarrite, döllingite, rutile, danalite, yttrium-calcium fluoride, cyrtolite, lepidolite, and fuchsite.—The effects of self-induction and distributed static capacity in a conductor, by Frederick Bedell, Ph.D., and Albert C. Crehore, Ph.D.—The quantitative determination of rubidium by the spectroscope, by F. A. Gooch and J. I. Phinney. The method is that of comparing photometrically the intensity of a certain line in the spectrum of the metal under investigation with the intensity of that given by a standard solution containing a known amount of the metal. A definite amount of the salt solution—usually the chloride—is taken up by a hollow coil of platinum wire, which may be made to take up constant quantities of liquid by taking care to plunge the coil while hot into the liquid, and removing it with its axis inclined obliquely to the surface. The coils were made of platinum wire 0·32 mm. in diameter, wound in about thirty turns to a spiral 1 cm. long by 2 mm. across, and twisted together at the ends to form a long handle. Each coil held 0·02 gr. of water. With such a coil, the blue rubidium lines were produced in a Muencke burner from 0·0002 mgr. of the chloride. Some test experiments showed that in the case of pure solutions of rubidium chloride the percentage could be found spectroscopically up to 1 part in 30,000 with an error as low as 1·25 per cent. In presence of potassium or sodium, however, the error may be as great as 20 per cent.—Notes on the meteorite of Farmington, Washington County, Kansas, by H. L. Preston.—A note on the cretaceous of North-western Montana, by H. Wood.—A deep artesian boring at Galveston, Texas, by R. T. Hill.—Notice of a new Oriskany fauna in Columbia County, New York, by C. E. Beecher, with an annotated list of fossils, by J. M. Clarke.—Description of the Mount Joy meteorite, by E. E. Howell.—Influence of the concentration of the ions on the intensity of colour of solutions of salts in water, by C. E. Linebarger.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 17.—"Stability and Instability of Viscous Liquids," by A. B. Basset, F.R.S. (Abstract.)—The principal object of this paper is to endeavour to obtain a theoretical explanation of the instability of viscous liquids, which was experimentally studied by Professor Osborne Reynolds.[1]

The experiment, which perhaps most strikingly illustrates this branch of hydrodynamics, consisted in causing water to flow from a cistern through a long circular tube, and by means of suitable appliances a fine stream of coloured liquid was made to flow down the centre of the tube along with the water. When the velocity was sufficiently small, the coloured stream showed no tendency to mix with the water; but when the velocity was increased, it was found that as soon as it had attained a certain critical value, the coloured stream broke off at a certain point of the tube and began to mix with the water, thus showing that the motion was unstable. It was also found that as the velocity was still further increased the point at which instability commenced gradually moved up the tube towards the end at which the water was flowing in.

Professor Reynolds concluded that the critical velocity W was determined by the equation

$$Wa\rho/\mu < n,$$

where a is the radius of the tube, ρ the density, and μ the viscosity of the liquid, and n a number; but the results of this

[1] *Phil. Trans.* 1883, p. 935.

paper show that this formula is incomplete, inasmuch as it does not take any account of the friction of the liquid against the sides of the tube.

In the first place, if the surface friction is supposed to be zero, so that perfect slipping takes place, the motion is stable for all velocities. If ϵ^{kt} be the time factor of a disturbance of wave-length λ, the value of k is

$$k = -\frac{2\iota\pi W}{\lambda} - \frac{\mu}{\rho a^2}\left(\frac{4\pi^2 a^2}{\lambda^2} + n^2\right) \quad . \quad . \quad . \quad . \quad . \quad (1),$$

where n is a root of the equation $J_1(n)=0$.

Experiment shows that when the velocity is greater than about six inches per second, the frictional tangential stress of water in contact with a fixed or moving solid is approximately proportional to the square of the relative velocity. This introduces a constant β, which may be called the coefficient of sliding friction, whose dimensions are $[ML^{-3}]$, and are therefore the same as those of a density. This constant may have any positive real value; $\beta = 0$ corresponding to perfect slipping or zero tangential stress, whilst $\beta = \infty$ corresponds to no slipping, which requires that the velocity of the liquid should be the same as that of the surface with which it is in contact. Owing to the intractable nature of the general equations of motion of a viscous liquid, I have been unable to obtain a complete solution, except on the hypothesis that β is an exceedingly small quantity. This supposition, I fear, does not represent very accurately the actual state of fluids in contact with solid bodies; but at the same time the solution clearly shows that the instability observed by Prof. Reynolds does not depend upon viscosity alone, but is due to the action of the boundary upon a *viscous* liquid.

To a first approximation, the real part of k is proportional to

$$\frac{Wa\beta}{\mu} - \frac{(n^2 + m^2a^2)^2}{4n^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2),$$

where $2\pi/m$ is the wave-length of the disturbance, and n is a root of the equation $(J_1 n) = 0$. Since the second term is a number, this shows that the motion will be stable, provided

$$Wa\beta/\mu < \text{a number.}$$

The experiments of Prof. Reynolds conclusively show that the critical velocity at which instability commences is proportional to μ/a; and the fact that the theoretical condition of stability turns out to be that Wa/μ, multiplied by a quantity of the same dimensions as a density, should be less than a certain number, appears to be in substantial agreement with his experimental results.

The results of the investigation may be summed up as follows:—

(i.) *The tendency to instability increases as the velocity of the liquid, the radius of the tube, and the coefficient of sliding friction increase; but diminishes as the viscosity increases.*

(ii.) *The tendency to instability increases as the wave-length $(2\pi/m)$ of the disturbance increases.*

The remainder of the paper is occupied with the discussion of a variety of problems relating to jets and wave-motion.

I find that when a cylindrical jet is moving through the atmosphere, the tendency of the viscosity of the jet is always in the direction of stability. The velocity of the jet does not affect the stability unless the influence of the surrounding air is taken into account; if, however, this is done, it will be found that it gives rise to a term proportional to the product of the density of the air and the square of the velocity of the jet, whose tendency is to render the motion unstable. The tendency of surface-tension (as has been previously shown by Lord Rayleigh) is in the direction of stability or instability according as the wave-length of the disturbance is less or greater than the circumference of the jet.

If in addition, the jet is supposed to be electrified, the condition of stability contains a term proportional to the square of the charge multiplied by a certain number, n. When the ratio of the circumference of the jet to the wave-length is less than 0·6, n is positive, and the electrical term tends to produce stability; but when this ratio is greater than 0·6, n is negative, and the electrical term tends to produce instability. It must, however, be recollected that when the above ratio is greater than unity the tendency of surface tension is to produce stability; but if the influencing body is capable of inducing a sufficiently large charge, the electrical term (when $2\pi a > \lambda$) will neutralize the effect of surface tension and viscosity, and the motion will be unstable.

The well-known calming effect of "pouring oil on troubled waters" has passed into a proverb. The mathematical investigation of this phenomenon is as follows:—The oil spreads over the water so as to form a very thin film; we may therefore suppose that the thickness l of the oil is so small compared with the wave-length hat powers of l higher than the first may be neglected. Also, since the viscosity of olive oil in C.G.S. units is about[1] 3·25, whilst that of water is about 0·014, the former may be treated as a highly viscous liquid, and the latter as a frictionless one.

The result is as follows:—

Let ρ_1, ρ be the densities of the water and oil, T_1 the surface tension between oil and water, T the surface tension between oil and air, μ the viscosity of the oil, and ϵ^{kt} the time factor, then, to a first approximation,

$$k = -\frac{\{g(\rho_1 - \rho) + T_1 m^2\}(g\rho - Tm^2)l}{4\mu\{g\rho_1 - (T - T_1)m^2\}}$$

For olive oil, $T_1 = 20·56$, $T = 36·9$, so that $T > T_1$; and I find that the motion will be stable unless the wave-length of the disturbance lies between about 9/11 and 6/5 of a centimetre. This result satisfactorily explains the effect of oil in calming stormy water.

OXFORD.

University Junior Scientific Club, October 26.—Mr. E. L. Collis, in the absence of Mr. Bourne, gave an exhibit of *Codium tomentosum*.—Mr. F. C. Britten gave an exhibit of the nest of a trapdoor spider.—Mr. Hill read an interesting paper on the determination of sex, which was followed by a long discussion.—Mr. Fisher exhibited some specimens of crystallized anhydrous oxalic acid, and described their methods of preparation.

CAMBRIDGE.

Philosophical Society, October 31.—Prof. G. H. Darwin, President, in the chair.—The following officers were elected for the ensuing session:—President: Prof. Hughes. Vice-Presidents: Dr. Cayley, Prof. G. H. Darwin, Dr. Hill. Treasurer: Mr. R. T. Glazebrook. Secretaries: Dr. Hobson, Mr. J. Larmor, Mr. Bateson. New Members of Council: Prof. Thomson, Mr. F. Darwin, Dr. Shore, Mr. Ruhemann.—The retiring President addressed the Society.—The following communications were made:—Note on the determination of low temperatures by platinum-thermometers, by Mr. E. H. Griffiths and Mr. G. M. Clark. The authors, following up the suggestion of Profs. Dewar and Fleming, that the resistance of certain pure metals vanishes at absolute zero, have assumed the possibility of extrapolating the platinum thermometer formulæ, and have thus found the temperature at which $R=0$. From the previously-published constants of seven different thermometers—including Callendar's original wire—the mean value deduced by them is $-273°·86$, which is in remarkable agreement with Joule and Thomson's thermodynamical value $-273°·7$. They further suggest that the simple method of determining the resistance in ice and steam and assuming $R=0$ when $t = -273°·7$ is sufficient to graduate a thermometer constructed of fairly pure wire, as they show that the errors so introduced will only amount to a fraction of a degree over the range $-273°$ to $+150°$.—Carnot's principle applied to animal and vegetable life, by Mr. J. Parker. The author discusses the question whether the conditions of the growth of plants are limited by the law of entropy. The assumption is made that Carnot's principle takes account only of the exchange of heat, and the temperature of the material system at which the exchange takes places; that the differential effect of solar radiation of different kinds consists in variation of the activity but not of the mechanical type of the growth. The increase of available energy due to the building up of inorganic materials into a plant can then only be explained, in conformity with the second law of thermodynamics, by the aid of differences of temperature during growth: the author gives calculations to prove that the difference between day and night is amply sufficient for this purpose.—Note on the geometrical interpretation of the quaternion analysis, by Mr. J. Brill.

[1] Osborne Reynolds, *Phil. Trans.* 1886, p. 17.

Paris.

Academy of Sciences, November 14.—M. d'Abbadie in the chair.—Heat of combustion of camphor, by M. Berthelot.—Remarks on a note by M. A. Colson on the rotating power of the diamine salts, by M. C. Friedel.—Researches on the chemical constitution of the peptones, by M. P. Schützenberger.—Influence of the distribution of manures in the soil upon their utilization, by M. H. Schlœsing.—On the laws of dilatation of gases under constant pressure, by M. E. H. Amagat. Tables are given of coefficients of expansion of carbon dioxide under pressures ranging from 50 to 1000 atm., and temperatures up to 258°; and for oxygen, hydrogen, nitrogen and air, under pressures up to 3000 atm. For CO_2 the coefficient has a maximum at a certain pressure for each range of temperature. This maximum corresponds to a higher pressure as the temperature rises. For the other gases the coefficient decreases regularly as the pressure increases. As regards temperature, the coefficient of expansion of CO_2 for each pressure reaches a maximum at a certain temperature and then decreases. This temperature is the higher, the greater the pressure. The more permanent gases behave as if they had already passed their maximum.—Study of the pathogenic power of fermented beet-root pulp, by M. Arloing.—Observations of the new comet Holmes (*f* 1892), made at the Paris Observatory (west equatorial), by M. G. Bigourdan (see Astronomical Column).—Transformation of the great telescope of the Paris Observatory for the study of radial velocities of the stars, by M. H. Deslandres (see Astronomical Column).—Summary of solar observations made at the Royal Observatory of the Roman College during the third quarter of 1892, by M. P. Tacchini.—On the inversion of Abelian integrals, by M. E. Goursat.—On the summation of a certain class of series, by M. d'Ocagne.—On the equations of dynamics, by M. R. Liouville.—Experimental researches on the deformations of metallic bridges, by M. Rabut.—Conditions of equilibrium and of formation of liquid microglobules, by M. C. Maltézos. The following experimental results were arrived at: When a liquid spreads over the free surface of a denser liquid, microglobules are produced on inverting the position of the two liquids. If a liquid rests in drops on the surface of a denser liquid, then in the inverse position the denser will spread over the less dense liquid.—Demonstration of the existence of interference of electric waves in a closed circuit, by means of the telephone, by M. R. Colson. A Rhumkorff coil was kept vibrating at 130 per second by a thermopile. To one of its terminals was attached a copper wire ending in a hook, to which a linen thread soaked in calcium chloride was attached by one end, the other hanging free. One of the terminals of a telephone was placed in contact with the thread, the other terminal being isolated. Under these conditions, the sound in the telephone was completely extinguished at a certain distance from the copper. When both the ends of the thread (which was 3 m. long) were connected up by fine copper wires, two points of extinction were reached, one from each end. On shortening the thread these points approached each other and formed a zone of extinction between them. This zone of extinction spread over the entire copper wires as the thread was shortened to zero. The neutral zone is due to interference of two waves of the same period and of equal potential meeting in opposite directions.—On the co-existence of dielectric power and electrolytic conductivity, by M. E. Cohn.—Observations on the preceding communication, by M. Bouty.—Magnetic properties of bodies at different temperatures, by M. P. Curie. These were measured by bringing samples of the bodies between the ends of two electromagnets inclined to one another, and measuring the forces experienced by means of a torsion balance. The bodies were heated in a porcelain crucible, the heat being supplied by platinum wires carrying a current, and measured by a Chatelier thermocouple.—On the propagation of vibrations through absorptive isotropic media, by M. Marcel Brillouin.—On a new relation between variations of luminous intensity and the numerical order of the sensations, determined by means of a luminous paint, by M. Charles Henry.—Essay of a general method of chemical synthesis: experiments, by M. Raoul Pictet.—On the fusion of carbonate of lime, by M. H. Le Chatelier.—On the molecular weights of sodammonium and potassammonium, by M. A. Joannis.—On some crystallized sodium titanates, by M. H. Cormimbœuf.—On a propylamidophenol derived from camphor, by M. P. Cazeneuve.—On the colouring matter of the pollen, by MM. G. Bertrand and G. Poirault.—On the manufacture of melanite garnet and sphene, by M. L. Michel.—On the rotating power of solutions, by M. Wyrouboff.—Researches on the mode of elimination of carbonic oxide, by M. L. de Saint-Martin.—Vital fermentations and chemical fermentations, MM. Maurice Arthus and Adolphe Huber.—Remarks on the preceding communication, by M. A. Gautier.—Influence of the transfusion of blood from dogs vaccinated against tuberculosis upon tuberculous infection, by MM. J. Héricourt and Ch. Richet.—On a new species of chromogenic bacteria, the *Spirillum luteum*, by M. Henri Jumelle.—On two parasitic myzostomes of the *Antedon phalangium* (Müller), by M. Henri Prouho.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Books.—Manners and Monuments of Prehistoric Peoples: Marquis de Nardaillac, translated by N. Bell (Putnam).—An Elementary Text-book of Hygiene: H. R. Wakefield (Blackie).—More about Wild Nature: Mrs. Brightwen (Unwin).—The Pharmacy and Poison Laws of the United Kingdom (office of the *Chemist and Druggist*).—Lessons in Elementary Algebra, 1st series: L. J. Pope (Bell).—The Visible Universe: J. E. Gore (Lockwood).—Man and the Glacial Period: Dr. G. F. Wright (K. Paul).—Sinai from the Fourth Egyptian Dynasty to the Present Day: late H. S. Palmer, new edition, revised by Prof. Sayce (S.P.C.K.).—Time and Tide, 2nd edition: Sir R. S. Ball (S.P.C.K.).—Les Races et les Langues: Prof. A. Lefèvre (Paris, Alcan).—A Contribution to our Knowledge of Seedlings, 2 vols.: Sir John Lubbock (K. Paul).—Australasian Newspaper Directory, 3rd edition, 1892 (Gordon and Gotch).—Sultan to Sultan: M. French-Sheldon (Saxon).

Pamphlets.—Recherches d'Optique Physiologique et Physique, Part 2: C. Royer (Bruxelles, Monnom).—Fauna Americana: D. T. de Aranzadi (Madrid).

Serial.—L'Anthropologie, tome iii. No. 4 (Paris, Masson.

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